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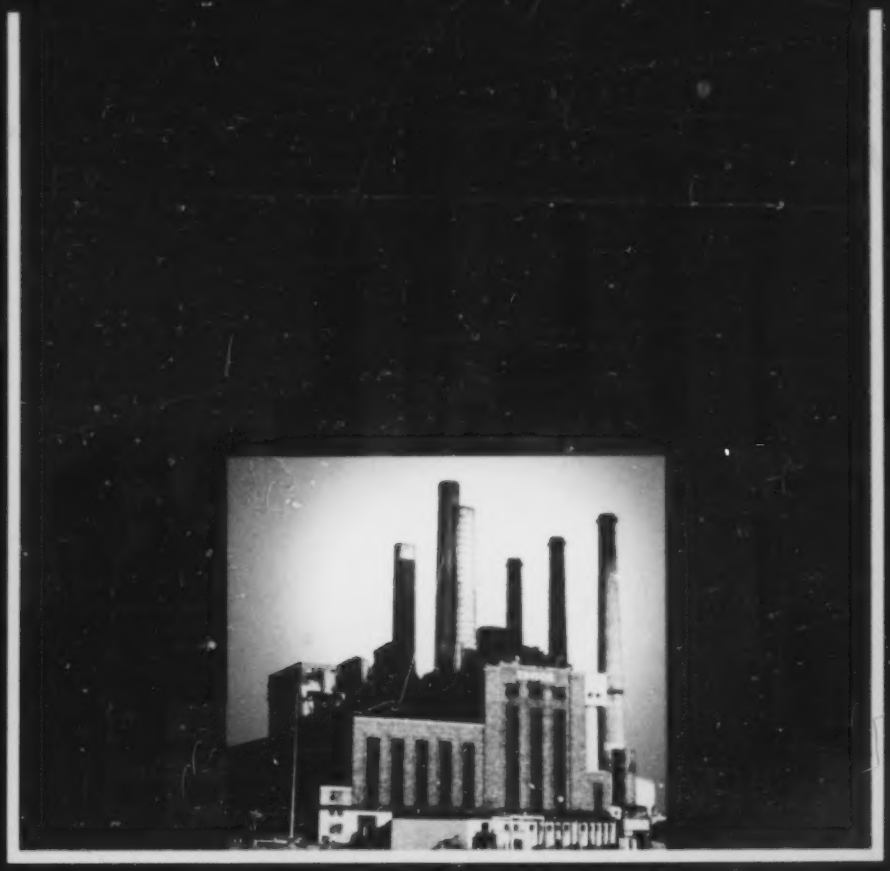

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A PERIODIC REPORT FROM BURNS AND ROE, INC. FALL 1985

Burns and Roe announces three key appointments

Burns and Roe has appointed **K. Keith Roe,** formerly president of Burns and Roe, Inc., president of Burns and Roe Enterprises, Inc., parent corporation for the Burns and Roe family of companies. He succeeds **Kenneth A. Roe,** who continues as board chairman and CEO.

Succeeding Keith Roe as president of Burns and Roe, Inc., is **Warren R. Cobean, Jr.,** formerly executive vice president.

E. Richard Kummerle, formerly vice president of Engineering Technology Division of Burns and Roe, Inc., appointed president of newly formed Engineering and Construction Services Division of Burns and Roe Enterprises.

Other appointments

Richard L. LeFebvre now general manager of Burns and Roe Construction Group. **J. Alan Forrest** now responsible for fossil power plant projects, and **Henry E. Bartoli** for fossil plant services. **Ashraf T. Dajani** now has responsibility for nuclear power projects plus project finance and development. **Tom W. DiFransico** now responsible for nuclear plant services. **S.C. "Andy" Marathe** is chief electrical engineer; **R. Gene Baggs** is assistant chief electrical engineer. **Jeffrey T. Whipple** is chief mechanical engineer; **Raymond M. Costello** is assistant chief mechanical engineer. **Morton H. Rothstein** is assistant chief civil engineer. **Thomas J. Jhun** now manager in the International Operations Division, with responsibility for activities in Far East Region. **Donald R. Becan** is now regional manager in Power Engineering Services Division. **Lewis C. Jeffrey** elected treasurer, and **Roger A. Fasnacht** has joined company as controller.

Kenneth A. Roe
Chairman and CEO
Burns and Roe Enterprises, Inc.

K. Keith Roe
President
Burns and Roe Enterprises, Inc.

W.R. Cobean, Jr.
President
Burns and Roe, Inc.

E. Richard Kummerle
President
Engineering and Construction Services Division
Burns and Roe Enterprises, Inc.

Current and recent Burns and Roe projects

Following is a partial list of current and recent Burns and Roe projects involving nuclear and fossil plants, power technology projects, and overseas projects.

Nuclear plant services

GPU Nuclear Corporation's Oyster Creek Nuclear Generating Station: projects involving upgrading of fire protection, and evaluation of structural conditions, material performance and equipment conditions of plant intake structure. **GPU**'s Three Mile Island Unit 1: projects involving addition of a safety features ventilation system for fuel handling building, and for addition of a reactor coolant inventory tracking system. **Southern California Edison**'s San Onofre Nuclear Station Units 1, 2 and 3: provision of operational schematics. **TVA**'s Browns Ferry Nuclear Plant: preparation of instrument setpoint calibration calculations.

Nuclear plant projects

U.S. Department of Energy: studies on large-scale prototype breeder reactors and on breeder reactor technology transfer; also serving as DOE's consultant on Shippingport decommissioning. **Teledyne Industries:** engineering study for decommissioning of NASA-owned Plum Brook nuclear reactor.

Fossil plant projects

Central Hudson Gas & Electric: reconversion of Danskammer Units 3 and 4 from oil-fired to coal.

Fossil plant services

Big Rivers Electric Corp.: continuing engineering services at D.B. Wilson Station. **Central Illinois Light Co.:** design review of Duck Creek Unit 1 boiler. **City of Jamestown, NY:** controls upgrade at Carlson Station.

Power technology projects

Electric Power Research Institute: studies involving oxygen control methods for pressurized water reactor secondary systems; development of utility data base on fabric filter installations; and evaluation of utility oil-fired boilers for conversion to coal/water fuels. **Chugach Electric:** studies on optimization of gas storage methods and energy utilization alternatives. **Public Service Electric & Gas:** study of repowering of existing steam units using combustion turbines. **City of Jamestown, NY:** design and construction of hot-water-based district heating system. **Babcock & Wilcox:** study of conversion of Consolidated Edison's Astoria Unit 10 to fluidized bed combustion.

Overseas projects

Korea: completion of three-year conversion of two 300MW oil-fired units to coal at Honam. Consulting services continue on 500MW coal-fired standardization program, and on two new nuclear plants in the 900MW range. **Taiwan:** conversion and retrofit of 350MW oil-fired unit to coal. **Australia:** engineering and design on two 300MW coal fired units in Western Australia. **People's Republic of China:** completion of feasibility study on two 900MW nuclear units in Fujian Province.

The Philippines: completion (as subcontractor to Westinghouse) of engineering work on Philippine Nuclear Power Plant No. 1, a 650MW unit. **Japan:** continuing project assignments for Mitsubishi on Japanese Demonstration Fast Breeder Reactor project.

Thailand: feasibility study of fluidized bed combustion using low-grade lignite. **Hong Kong:** an assessment of T&D system. **Dominican Republic:** plant design upgrade of six fossil-fired plants.

Southeast Regional Headquarters relocated

Burns and Roe's Southeast Regional headquarters has relocated from Jacksonville to 7800 Southland Blvd., Orlando, Florida 32809.

J.J. Byrnes, vice president, is in charge of the Orlando office.

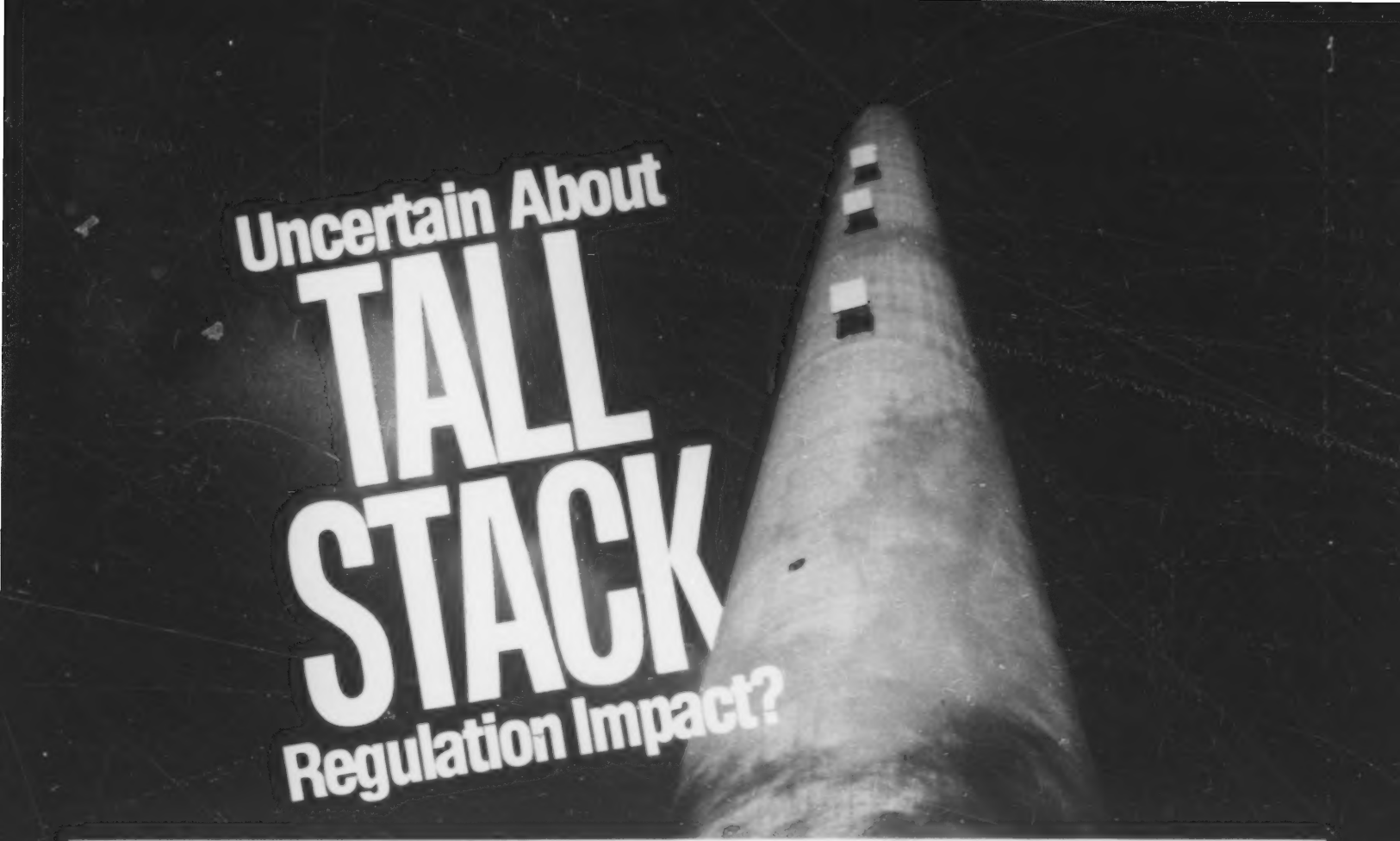
The relocation was undertaken to provide better service to Burns and Roe's utility clients in Southeast.

New TOPS brochure

A four-page, full-color brochure featuring Burns and Roe's new Thermal On-line Performance System (TOPS) is available upon request.

TOPS is a computerized operating tool for use in fossil-fired power plants. It monitors all plant components—up to 150 signals, including flow, pressure and temperature—to develop comprehensive data on the plant's efficiency. Using these data, TOPS calculates the efficiency levels of the plant and its major components.

For a copy of the TOPS brochure, call **Bus Cobean** at (201) 265-2000 or write him at Burns and Roe, 800 Kinderkamack Road, Oradell, NJ 07649.



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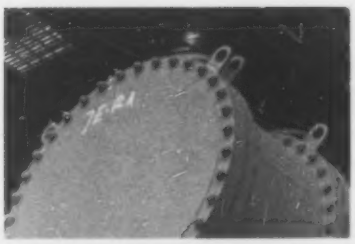

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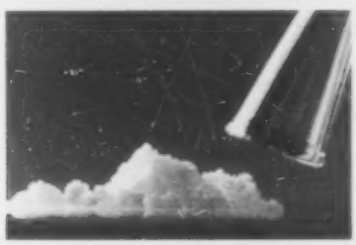

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Clean Coal Technology: Just in Time

If federal help comes now, the commercialization of clean coal technology can give electric utilities, the environment, and the economy a big boost.

Clean coal technology can make a big difference in how America's power plants do their job.

Coal combustion methods, which have changed little since the introduction of pulverized coal boilers in the 1920s, are now being adapted to meet today's environmental, economic, and financial realities. From coast to coast, electric utilities are on the brink of commercializing new technologies that have been looking good in the research and development stage.

The new technologies range from the basic, such as improved coal cleaning, to the exotic, such as magnetohydrodynamics. The humble lump of coal is being crushed, ground, sifted, dewatered, pulverized, micronized, pressurized, and desulfurized. It is being subjected to microwaves and magnetism, tossed around in a "fluidized bed," and transformed into a clean-burning gas.

As a result of such high-tech manipulation, coal can be burned more cleanly than ever—with 90 to 99 percent of its potentially polluting sulfur content removed. In addition to this environmental benefit, clean coal technology offers numerous other advantages over conventional combustion and pollution control methods: less solid waste, less overall cost, shorter construction time, reduced power plant financing charges, improved efficiency, and the ability to use a wider range of fuels.

Clean coal technology is entering the scene at a crucial time. Electric utilities, which have been minimizing construction during the last decade, must begin building new power plants to avoid possible brownouts and blackouts near the turn of the century. Since nuclear power plants have become too costly and problematical, coal has emerged as the only reliable domestic fuel for baseload power plants. "Electric utilities need to demonstrate new technologies as expeditiously as possible in order to have them commercially available during the middle part of the 1990s," said Thomas R. Kuhn, executive vice president of the Edison Electric Institute (EEI).

To demonstrate new technologies in a regulated, "risk-adverse" industry, however, federal support is needed, Kuhn pointed out. "As a regulated industry, utilities do not have the flexibility to compensate for the financial risk of new technology demonstrations in a manner similar to other private sector industries," he said.

Commented Jack H. Ferguson, president and chief operating officer of Virginia Power, "Without federal support, we could easily have a situation in which utilities will not embrace, and their regulators will not permit, new technology until it is demonstrated by another company. . . . While this may be a prudent approach for each utility and its regulators, it will not be in the best interest of the nation."

Leslie Braunstein is a writer and communications consultant specializing in energy and economic issues.

Indicating its confidence in clean coal technology's future, the electric utility industry already has invested hundreds of millions of dollars in research and demonstration programs, independently and through contributions to the Electric Power Research Institute (EPRI). And the efforts are beginning to pay off. Successful demonstration of new technologies is causing excitement throughout the industry.

Fueling this excitement is the success of the Cool Water coal gasification demonstration plant in California's Mojave Desert. Since the summer of 1984, the 120-megawatt (MW) power plant has been converting 1,000 tons of coal per day into a clean synthetic gas, which has been used to provide electric power for about 100,000 households. It was built in just under 29 months—about one-third the time it takes to build a conventional coal-fired power plant. Its emissions have averaged one-tenth of permissible levels, leading sponsors to call Cool Water "the world's cleanest coal plant."

Cool Water's equity owners are Texaco Inc., Southern California Edison Company, EPRI, Bechtel Power Corporation, General Electric Company, and the Japan Cool Water Program Partnership. The Empire State Electric Energy Research Corporation (ESEERCO) and Standard Oil Company of Ohio contributed additional funding, and the Synthetic Fuels Corporation is providing price supports

Electric Power Research Institute

Heat exchangers and process columns are critical to the success story at the Cool Water coal gasification demonstration plant.

Southern California Edison Company

"The world's cleanest coal plant"—the California IGCC project was built so quickly and has reduced emissions so remarkably that excitement is rippling throughout the electric utility industry.

during the plant's first five years of operation. After the demonstration ends in June 1989, Southern California Edison may buy the facility.

Welcoming the good news from California, other utilities are now exploring the prospects of coal gasification. For example, the Potomac Electric Power Company (PEPCO) is considering the construction of a 360-MW commercial plant using the Cool Water integrated gasification combined cycle (IGCC) technology, which could be brought on line in three phases beginning in 1995. Two 108-MW combustion turbines would be scheduled to begin service in 1995 and 1996 respectively, to be augmented by a coal gasifier and heat recovery generators providing 144 MW of power beginning in 1997. "PEPCO's tentative plans have been influenced by the success of the Cool Water project," said company spokesman Tom Welle, adding that many of the 35 member utilities of the Utility Coal Gasification Association are contemplating building IGCC plants in the 1990s.

Another clean coal technology showing near-term commercial promise is fluidized bed combustion. Encouraging results at the Tennessee Valley Authority's (TVA) 20-MW pilot plant near Paducah, Kentucky, have helped spur interest in this environmentally advantageous method of using coal. Participating along with TVA in the test program are EPRI, Duke Power Company, the State of Kentucky, and Babcock & Wilcox which designed and built the boiler and associated equipment with aid from Stone & Webster.

Successful operation of the pilot plant since 1982, highlighted by up to 95 percent sulfur removal (depending on the type of coal and other factors), has led the sponsors to proceed to a larger, commercial-scale demonstration. A 160-MW unit, with the boiler to be built by Combustion Engineering, is slated to begin operating in 1988. After a four-year test program, it should begin full commercial operation in 1993.

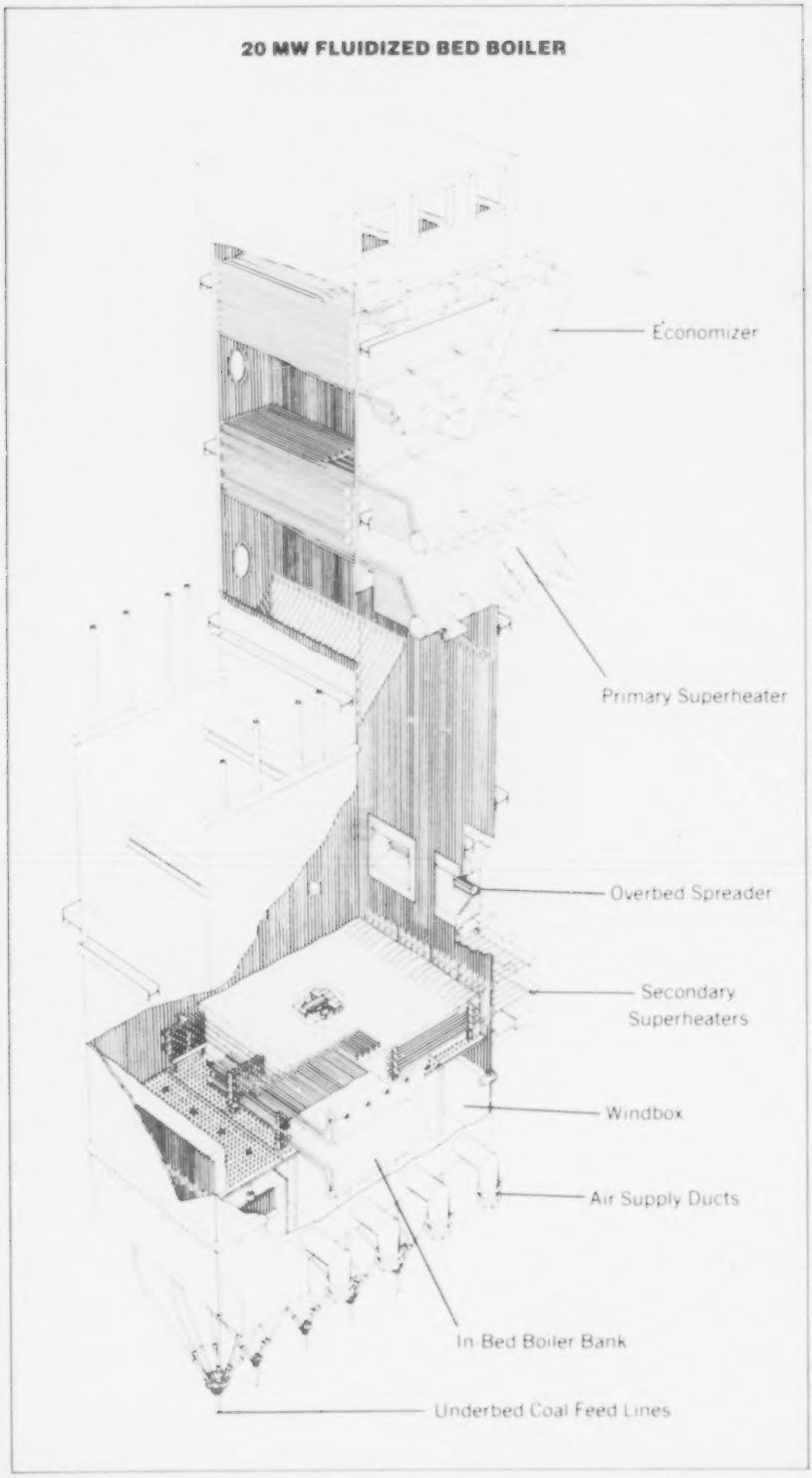
Although the integrated gasification combined cycle process and fluidized bed combustion are considered "front-runners" for new power generation, they are but two of a wide variety of clean coal technologies being developed by both industry and government. Different technologies will be required to meet the diverse needs of utilities. Some of the most promising technologies are still in the early stages of development.

Many major ongoing coal research programs began some time ago, during the 1960s, in response to concern about the environmental effects of coal combustion. That concern remains an important issue today, as the nation turns to coal for an increasing share of its energy needs.

Clean Coal and the Environment

Emerging coal technologies are designed to comply with environmental regulations in a cost-effective manner. The Clean Air Act, enacted originally in 1963 and amended in both 1970 and 1977, seeks to control the release of sulfur dioxide, nitrogen oxides (NOx), and particulates from coal-burning power plants. The Environmental Protection Agency's (EPA) New Source Performance Standards, first issued in 1971 and revised in 1978, require new power plants to remove 70 to 90 percent of the sulfur oxide emissions from their flue gases. Proposed Clean Air Act amendments would require extensive modifications to older coal-burning power plants.

To date, the primary method for complying with existing environmental regulations has been installation of a flue gas desulfurization system known as a "scrubber." This technology has been effectively re-



Its boiler designed and built by Babcock & Wilcox, TVA's pilot plant for atmospheric fluidized bed combustion is getting dramatic results.

quired for all new pulverized coal-fired power plants since 1977.

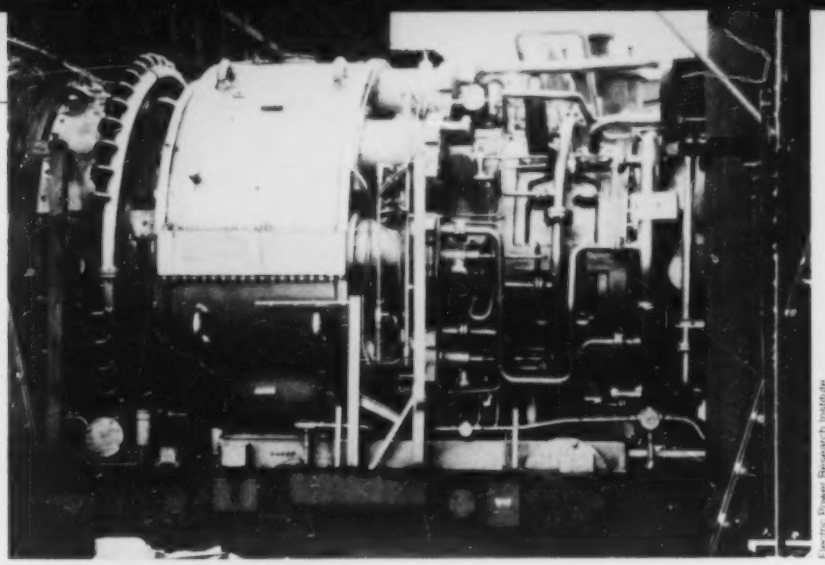
"Scrubbers have proven to be among the most costly and least reliable pieces of equipment in the utility industry," said Richard E. Balzhiser, senior vice president for research and development at EPRI. He pointed out that the typical scrubbing system creates a tremendous amount of solid waste, can cost up to $100 million, uses huge amounts of water (more than 1,000 gallons per minute), and consumes 3 to 8 percent of the power plant's total energy output. In addition, it is subject to fouling and corrosion, and its maintenance cost is two to 20 times that of the rest of the power plant.

There are now about 120 scrubber-equipped generating units operating at U.S. utilities; more than 100 additional units are planned or under construction. Together with greater use of low-sulfur fuel, they have helped reduce air pollution in the United States considerably. According to EPA, total sulfur dioxide emissions dropped 28 percent throughout the country from 1973 to 1983. Emissions from electric power plants dropped 19 percent during that period, while power plant coal use increased by more than 60 percent. Despite these improvements in air pollution control, however, the acidity of rainfall in the Northeast has not changed appreciably in the last 15 years.

It is this conundrum that is fueling the current debate over proposed additional acid rain legislation. One side seeks further reductions in sulfur dioxide emissions; the other side argues that other factors also may contribute to

the acid rain problem. "In essence, the debate has been reduced to an argument over which sources should be forced to further control sulfur dioxide emissions, by what means, and at whose expense," said Balzhiser. Utility industry planners see far greater promise in the commercialization of new coal-burning technology than in further construction of costly and complex scrubbing systems.

Research and demonstration programs have provided data showing both the short-term and long-range environmental benefits of new coal-burning technologies. As shown in Table 1, six new coal combustion technologies could control emissions as effectively or better than a conventional coal-fired power plant equipped with flue gas desulfurization. In the long term, as shown in Figure 1, the results may be even more dramatic. Retrofitting older power plants with new pollution control equipment would reduce emissions in the short term—between 1990 and 2010. At about that time, however, increasing demand for electricity would cause emissions to begin rising again, eventually returning to current levels. Alternatively, the introduction of new coal technology would cause sulfur dioxide emissions to begin dropping by the mid-1990s and to continue dropping steadily through the next three decades.



Electric Power Research Institute

A gas turbine powered by syngas works in combined cycle with a steam turbine to produce 120 MW of electricity at Cool Water.

New Coal Technology to Meet Growing Electricity Demand

In addition to offering long-term environmental advantages, clean coal technology appears to be one of the few practical options for meeting the nation's growing demand for electric power through the early part of the next century.

Federal government and industry forecasters have predicted that the demand for electric power will grow at an annual rate of 2 to 4 percent through the year 2000. "Even after considering the effects of conservation, load management techniques, and cogeneration, the electric utility industry, on a national average, is projecting an annual growth in consumption of 2.7 percent," said Kuhn. Figure 2 shows projected power demand with annual demand growth rates of 2.0 percent, 2.5 percent, and 4.0 percent. New capacity will be needed

Table 1

Pollution Control Potential of New Coal Technologies

Technology	Sulfur oxide (percent removal)	Nitrogen oxide emissions (lb/10^6 Btu)	Particulate emissions (lb/10^6 Btu)
Conventional Pulverized Coal Technology with Flue Gas Desulfurization*	90-98	0.5-0.6	0.03
Atmospheric Fluidized Bed Combustion	90-95	0.2	0.01
Advanced Pulverized Coal/Flue Gas Desulfurization	90-95	0.2-0.3	0.01
Pressurized Fluidized Bed Combustion	90-95	0.1	0.01
Gasification Combined Cycle	90-99	0.1-0.3	0.003
Fuel Cell Gasification Combined Cycle	99+	0.003	nil
Limestone Injection with Staged Combustion/Baghouse or Precipitator (Slagging Combustor)	90-95	0.1	0.01

*EPA New Source Performance Standards
Source: Edison Electric Institute

not only to meet growing demand, but also to replace deteriorating power plants, displace high-cost fuels, and provide a reserve margin for reliability.

Utilities must plan now to add substantial amounts of new capacity in the 1990s—at least 10,000 MW each year after 1992, according to an EPRI calculation—because capacity margins are dropping, and electric power demand is expected to increase steadily even if overall economic growth rates are modest. A number of developments have contributed to this situation:

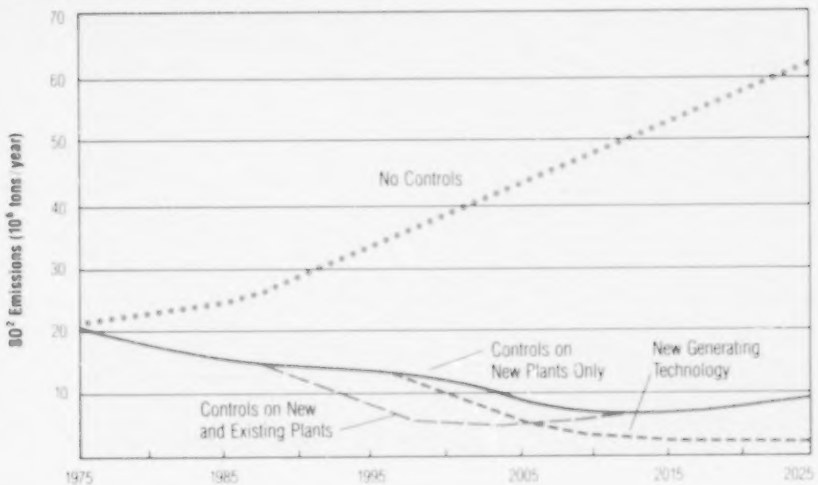
- Oil price hikes, conservation, and slowed demand growth rates during the 1970s left utilities with high capacity margins.
- Utilities adopted policies to minimize capacity margins and cancelled power plants. Now margins are dropping and may reach dangerously low levels in the next decade if current trends continue.
- The financial difficulty of completing nuclear power plant construction, exacerbated by the Three Mile Island incident, led to further plant cancellations.
- Even in periods of slow economic growth, the demand for electric power has been rising. In the decade following 1972, while U.S. energy use dropped by 5 percent and oil use dropped by 13 percent, energy devoted to electricity production rose by 22 percent. Presently accounting for about a third of the nation's energy use, electric power may provide half the nation's energy demand by the end of the century.

As shown in Table 2, EPRI projects a need for up to 420 gigawatts (GW) (1 gigawatt = 1,000 megawatts) of new electric generating capacity in the 1990s. About 131 GW are planned for service between 1985 and 1993. If electric power demand grows more than 3 percent annually, each percentage increase will translate to an annual additional new power generating requirement of 100 GW.

To meet the increasing electric power demand, coal will play a major role. The financial and regu-

Figure 1

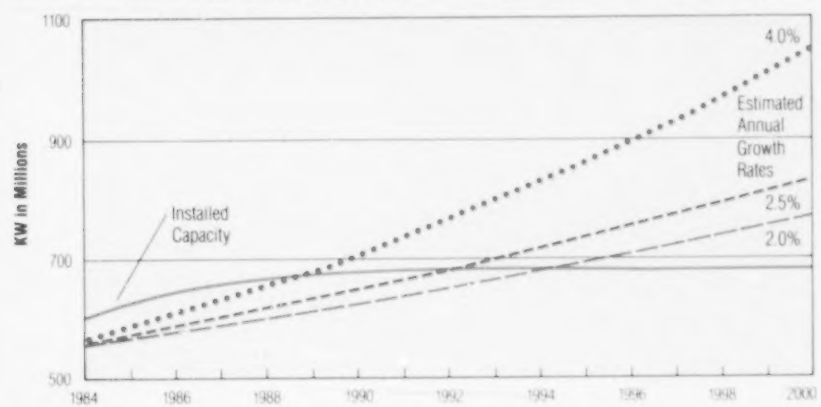
Utility Emission Trends, 1975-2025



Source: *EPRI Journal*, Electric Power Research Institute, November 1983, p. 50.

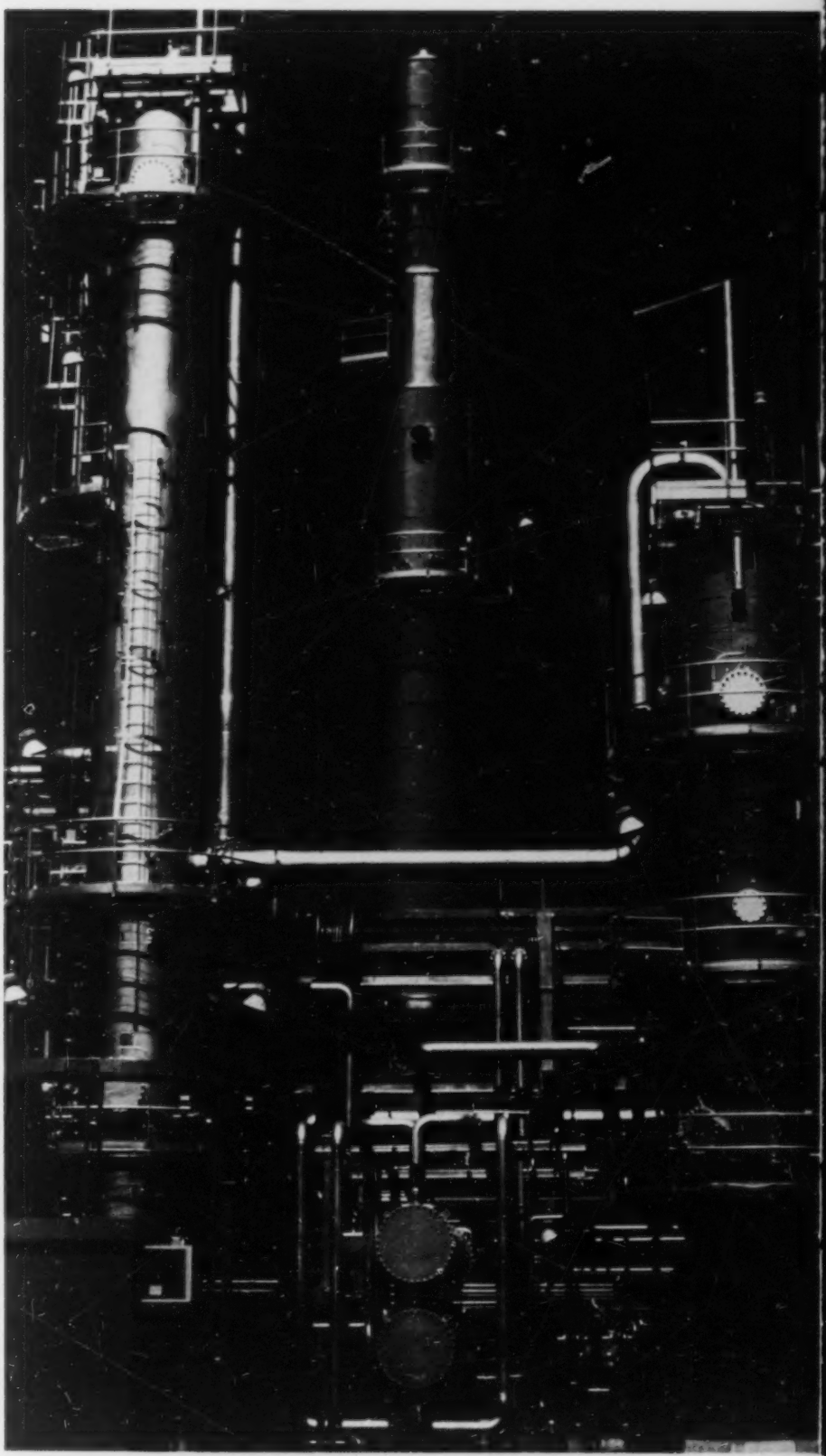
Figure 2

U.S. Electric Generating Capacity and Peak Demand, 1984-2000



Note: Peak demand at stated growth rates with 20% capacity margin needed for dependable supply; includes existing capacity and capacity under construction less retirements of 15 million kilowatts through 1993 as reported to North American Electric Reliability Council (NERC).

Source: Report of the Edison Electric Institute, February 1985, p. 19.



The Cool Water demonstration plant removes up to 99 percent of sulfur oxide.

latory difficulty of building new nuclear power plants has virtually eclipsed that once-promising source of baseload power. No new nuclear plants have been ordered since 1978. The long-term price and supply of oil and natural gas remain too uncertain for planned baseload power use. Coal, which currently provides more than half the nation's electricity, may have to satisfy up to 70 percent of America's power demand as the century closes.

To demonstrate new technologies in a regulated, "risk-adverse" industry, federal support is needed, Kuhn pointed out.

The Need for Modular Power Plants

The electric utility industry's current financial situation is one of the major factors driving the need for new coal-based technology. During the 1960s and early 1970s, the industry thrived on growing demand for electricity, low inflation, low fuel cost, improvements in technical efficiency, and expanding economies of scale. Now, of course, the situation has been reversed. Utilities face high fuel cost, uncertain demand growth, higher inflation, and costly construction delays. "In some cases, the cost of adding a baseload generating plant can exceed the net worth of a company," notes EEI's Kuhn. "Frequently, construction is a threat to the financial standing of a company. Financial incentives are to forego construction if at all possible."

Table 2

Increased Need for Electric Power Capacity in the 1990s
(Annual electric power demand growth at 3%)

	Potential Capacity Needs Gigawatts (GW)
Electricity demand growth rate at 3%	190
Offset retirements or declining performance	60
Maintain gross peak reserve margin at 30%	80
Potential nuclear deferments or cancellations	40
Impact of possible acid rain legislation	20
Impact of possible oil cutoff	30
Total	420

Source: Electric Power Research Institute

"We are now in a slower growth, rising cost planning environment," Kuhn continued. The imperatives of this situation, aside from attempting to change the ways in which utilities are regulated and financed, include:

- building smaller baseload power plants,
- reducing construction lead times, and
- matching supply increments more closely with demand.

These needs are interrelated. Smaller power plants, simply by being smaller, could more easily keep pace with slow-growing demand and require less time to plan and build. Furthermore, plants which promise minimal adverse impact on the environment could receive rapid regulatory approval, avoiding costly construction delay. There is a possibility that power plants built in a modular fashion could be "eased" into the rate base, lessening "rate shock." Thus new power generation technologies have great potential for public acceptance, from both an environmental and an economic standpoint.

The New Technologies

With coal, there are opportunities for pollution control before, during, and after combustion. New technologies are being developed to attack the pollution problem at each of these three stages. In addition, there are combined and advanced systems under development, some of which avoid the combustion process altogether. The needs of individual utilities will help dictate the choice of applicable technologies as they become commercially available.

Pre-Combustion Technologies

Before it is burned, coal can be cleaned and/or mixed with other substances to enhance combustion efficiency, to reduce the cost of maintaining boilers and equipment, and to remove potential pollutants. Physical coal cleaning methods involve grinding the coal into a sand-like powder and separating out impurities, resulting in removal of 20 to 50 percent of the coal's sulfur content. Research is aimed at removing up to 90 percent of the sulfur, primarily by grinding coal down further to the consistency of talcum powder. Such "micronized" coal would be 10 times finer than the ground coal produced by current methods. The Coal Cleaning Test Facility near Homer City, Pennsylvania, has spearheaded research in this area since 1981. Its sponsors are EPRI, Pennsylvania Electric Company, New York State Electric and Gas Corporation, and ESEERCO.

Other physical coal cleaning approaches focus on different ways to remove impurities during the cleaning process. Some techniques involve treating the ground coal with an oil-based substance that adheres only to coal particles and not to impurities. After the treated coal powder is agitated, impurities can be removed efficiently. In another approach, magnetic force is used to remove sulfur.

In a water-based system, once coal is ground to a very fine powder and cleaned, it must be dried or "dewatered" for shipping and burning. Established dewatering methods are unlikely to work well with extremely fine coal powders. Research is directed at developing new dewatering methods, such as one using microwaves, as well as ways to force cleaned coal particles to "agglomerate" or bind together.

Other coal cleaning approaches involve the use of chemicals, microwave energy, and even bacteria. For example, one research group is using Freon in a cyclone separator to remove up to half of the overall sulfur content (both pyritic and organic) in very fine coal. Another project, based on the fact that microwaves pass through coal but not through sulfur or other impurities, has reduced ash and sulfur by almost 90 percent in laboratory tests.

Southern California Edison Company

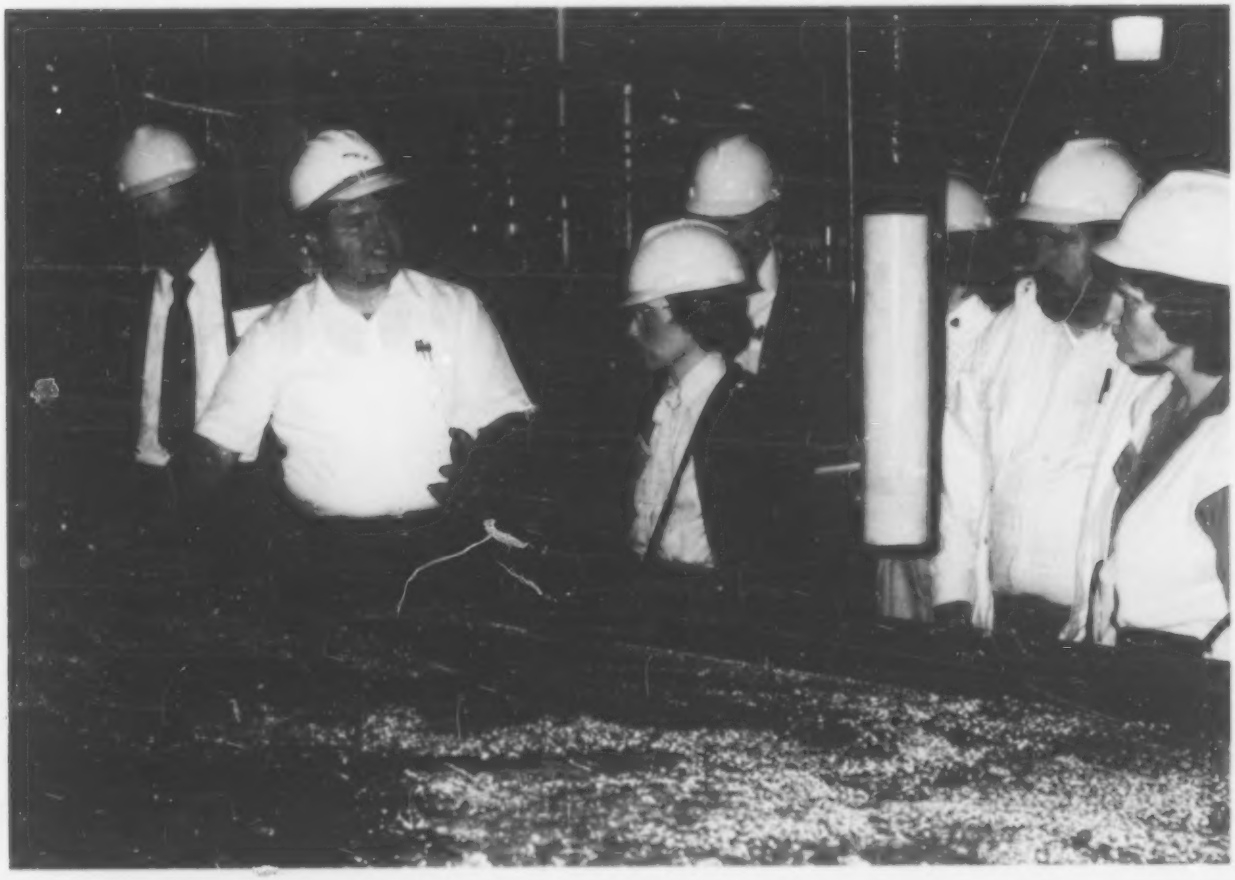
And in yet another experiment, bacteria removed 90 percent of the organic sulfur from coal in five to ten days.

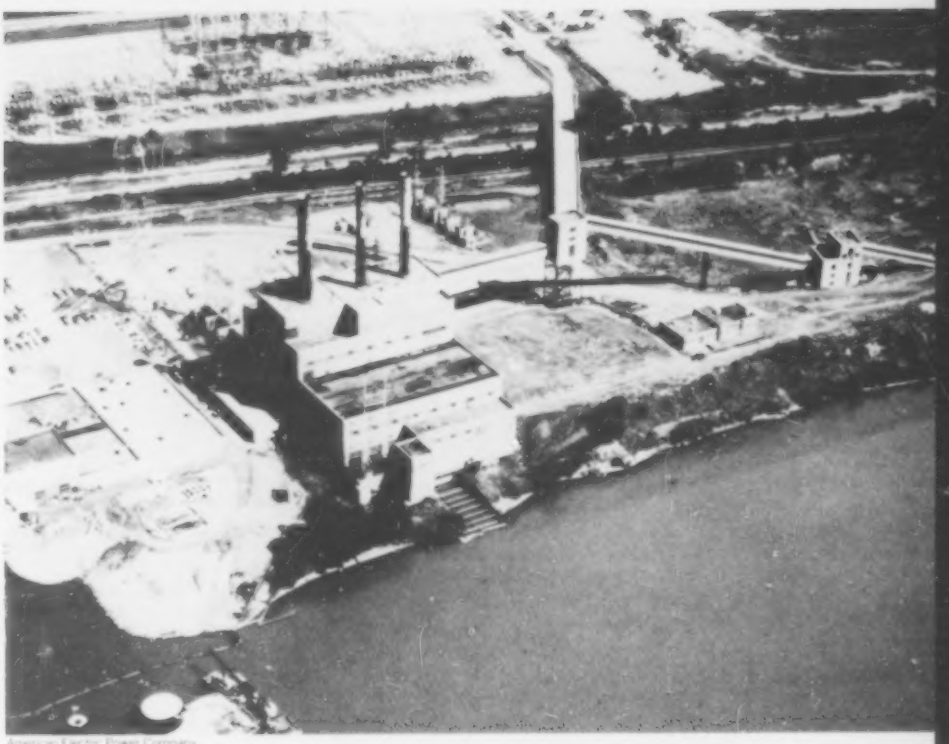
Once coal has been reduced to a relatively clean powder, it can be mixed with oil, water or other substances to be burned instead of oil if necessary. Coal/oil mixtures, first used in the 1920s, are presently commercial in the United States, but are seldom used by utilities due to their high cost. Coal/water "slurries" using 70 percent coal and 30 percent water have burned cleanly in test burns, but utility-scale demonstrations have not taken place. Pipeline slurries using 50 percent coal and 50 percent water, demonstrated domestically 20 years ago, may help bring relatively inexpensive coal-based energy to power plants located far from coal-mining regions.

New Coal Combustion Techniques

Much of the excitement over new coal technology focuses on processes which modify the way in which coal is burned in order to remove potential pollutants during combustion and to improve thermodynamic efficiency. In addition to the atmospheric fluidized bed combustion approach being tested near Paducah, Kentucky, major utility demonstrations of this technology also are being built at Burnsville, Minnesota, (125 MW) and at Nucla, Colorado, (110 MW). The Minnesota facility, to be operated by Northern States Power Company, is scheduled to come on line in 1986. Colorado Ute Electric Association's Nucla plant is scheduled to begin operating in 1987. About 40 industries in the United States have ordered atmospheric fluidized bed boilers, and many manufacturers are vying to enter the market. "Not since the early days of nuclear power have technology developers competed so keenly," stated *Energy Daily* July 3.

Clark Harrison, site manager at EPRI's coal cleaning facility, tells a press tour how the concentrating table works like panning for gold. When coal is slurried onto the ribbed surface, the table shakes and separates the lightweight coal from the heavier impurities.





American Electric Power Company

American Electric Power wants to convert this conventional coal-fired plant to a super-efficient pressurized fluidized bed combustion facility.

In atmospheric fluidized bed combustion, powdered coal mixed with limestone is burned while suspended on a "bed" of air. The calcium in the limestone combines with the sulfur in the coal to form a dry, solid waste product, calcium sulfate. In this manner, not only is the need for scrubbers eliminated, but the solid waste disposal problem is minimized. Furthermore, the process uses lower combustion temperatures, resulting in lower nitrogen oxide emissions. Atmospheric fluidized bed combustion offers unprecedented fuel flexibility; it can cleanly burn such low-grade fuels as peat, tree bark, industrial and sewage sludge, oil shale, lignite, and even cow manure.

A more advanced version of the fluidized bed combustion concept is the pressurized fluidized bed combustor (PFBC), in which hot pressurized combustion gases are used to power a gas turbine. Waste heat from that process, in turn, produces additional steam to drive a turbine. This combined cycle increases the efficiency of the total process—to about 40 percent, from standard levels of about 33 percent. Research focuses not only on demonstrating the technology, but also on preventing abrasive particulates from eroding turbine blades and other equipment.

In one pressurized fluidized bed combustion approach, called turbocharged PFBC, gas is cooled in a convection pass above the fluidized bed before it enters the gas turbine. This lower inlet temperature helps reduce gas turbine blade deterioration. Several utilities have expressed interest in this technology, which may eventually offer lower unit cost and shorter construction lead time than some of its competitors. American Electric Power Company has proposed a 70-MW demonstration at Brilliant, Ohio, in cooperation with Babcock & Wilcox and ASEA-PFBC. Power company officials have said that if federal assistance can be obtained, the plant could be operating by 1990.

In addition to modifying the combustion process with technologies such as fluidized bed combustion in order to reduce sulfur oxide emissions, combustion modifications can also be made to reduce nitrogen oxide emissions. Low-NOx burners are commercially available; advanced low-NOx burners, presently being introduced to the market, reduce emissions further by controlling the fuel/air mix, temperature, and combustion chemistry.

In the future, new low-NOx burners could be retrofitted along with another new combustion modification system that reduces sulfur dioxide emissions: furnace sorbent injection. The leading furnace sorbent injection system is the limestone injection multistage burner (LIMB), which introduces dry limestone directly into the combustion furnace to capture the coal's sulfur content. EPA- and EPRI-funded research aims to improve this technology's efficiency and reliability and to achieve a 50 to 70 percent reduction in sulfur dioxide emissions. The largest LIMB projects include a 640-MW boiler operated by the Pennsylvania Electric Company and a 104-MW demonstration at Ohio Edison's Edgewater plant.

Post-Combustion Pollution Control

If potential pollutants cannot be removed from coal before or during combustion, then post-combustion pollution control measures must be used by many power plants. The most problematical pollutant is sulfur dioxide; the major sulfur dioxide removal

method, as mentioned earlier, is flue gas desulfurization. EPRI has invested $50 million to date in efforts to improve this technology's performance. EPRI's research, to be augmented by an additional $50 million investment over the next five years, includes failure cause analysis, process chemistry improvement, materials study, hardware design, study of water and energy use, and the collection and interpretation of performance data.

Advanced scrubbing concepts, currently being tested with federal and private sector funds, may supplant flue gas desulfurization in the long term. In one approach, electron beams pass through combustion gas that has been treated with ammonia, converting sulfur dioxide and nitrogen oxides to dry materials.

In an important first step at the end of July 1985, the House of Representatives voted $500 million over the next three years. . . . The focus now shifts to the Senate.

Post-combustion pollution control technology also includes the use of baghouses and electrostatic precipitators to remove particulates from combustion gases. A baghouse is an array of bags, typically about 50 feet long, with powerful fans that vacuum particulates out of flue gases. In a precipitator, electrically charged particulates are attracted to high-voltage metal plates. The performance of precipitators can be adversely affected by scrubbers and other pollution control equipment. For this reason, industry and government are seeking to upgrade existing precipitator technology, as well as developing advanced systems.

Coal Gasification, Liquefaction, and Combined Cycle Systems

Another pollution control approach is to change the coal into a clean liquid or gaseous fuel prior to combustion. Coal-based synthetic fuel technology was developed in

PROSPECTS FOR FEDERAL SUPPORT

Federal support for a proposed clean coal technology program is likely, but it faces an arduous journey through the Congressional appropriations process. The Administration, and hence the Department of Energy (DOE), has stated that commercial demonstrations of new technologies should be conducted by the private sector, without government support.

Last year, Congress established a $750 million Clean Coal Technology Reserve (CCTR) in Public Law 98-473, the continuing appropriations resolution. The purpose of the CCTR was to support cost-shared demonstrations of clean coal technologies in electric utility and large industrial applications.

Congress also directed DOE to solicit "expressions of interest and informational proposals" from industry. DOE did so last November, stating that it had no resources to fund any of the proposed activites and did not anticipate funding any of the proposals submitted. Nonetheless, it received 175 responses, with project values totaling over $8 billion. Investor-owned electric utilities responded with over 30 proposals.

Congress must now appropriate funds for the program before projects can be initiated. In an important first step at the end of July 1985, the House of Representatives voted $500 million for the program over the next three years, after defeating an amendment to cut funding to $100 million. The funds would be provided as follows: $100 million in FY 86, $200 million in FY 87, and $200 million in FY 88.

The focus now shifts to the Senate, where consideration of funding for the program is expected to take place in mid-September. Should the Senate action differ from that taken by the House, those differences will have to be resolved in a Senate-House conference.

Tennessee Valley Authority

Atmospheric fluidized bed combustion offers unheard-of fuel flexibility as well as up to 95 percent sulfur removal. Now TVA and its partners plan to scale up to 160 MW at Paducah.

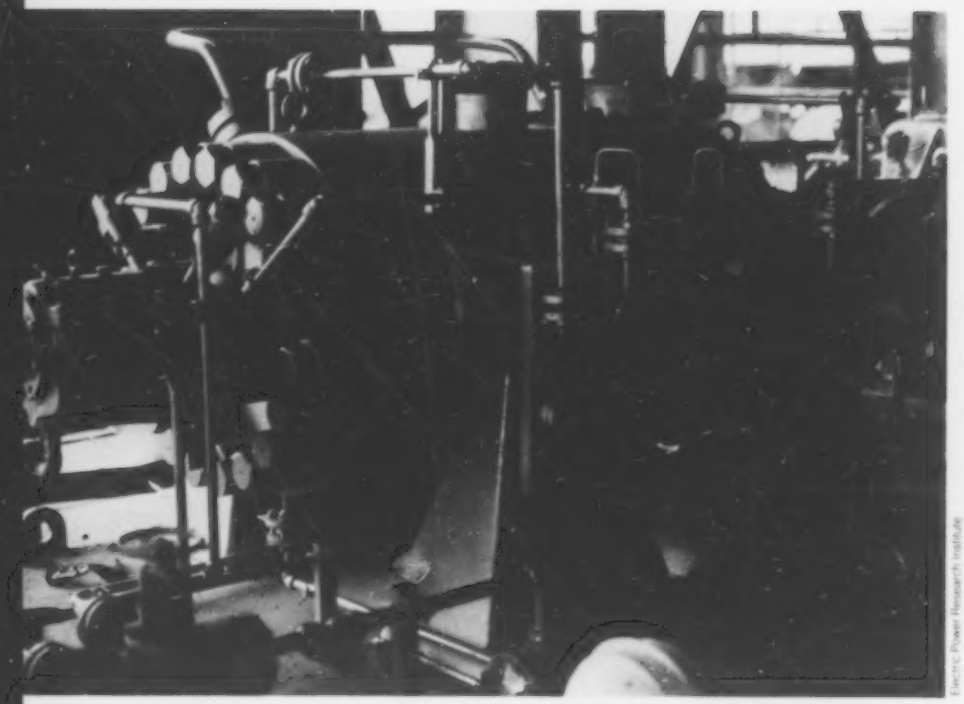
Germany during World War II. Since then, synfuels interest in the United States has waxed and waned with fluctuations in oil price and availability. Despite current low oil prices, however, there is renewed interest in synfuels technology that can meet the constraints of today's power plant economics.

One such technology, noted earlier, is integrated gasification combined cycle, as presently being demonstrated at the Cool Water plant near Daggett, California. At Cool Water, coal is first converted to a clean synthetic gas in a gasifier developed by Texaco. (Other gasification combined cycle facilities may use different gasifiers.) The resulting hot gas (2,300-2,800 degrees F.) must be cooled before being desulfurized and then fired in a gas turbine. The cooling process yields high-pressure steam. Both the steam and the cooled gas are used to generate power in a combined cycle turbine system. Then waste heat from the gas turbine is recovered and used to generate steam for additional power generation. The total energy conversion efficiency is about 37 percent.

Recent EPRI studies indicate that a power plant of 500 or 600 MW using the Cool Water technology would cost about 10 percent less to build than a new direct coal-fired power plant with flue gas desulfurization. Its economic attractiveness is due primarily to its modular construction. Prefabricated power plant units can be delivered relatively quickly, reducing construction lead times and capital risk. Modular construction could enable utilities to order smaller units to more closely match supply with demand and minimize "rate shock."

Cool Water's emission rates during its first year of operation were far below permissible EPA levels. The mineral residue from the combustion process, recently classified as non-hazardous by California authorities, can be used as material for insulation and road building. Yet another environmental benefit is the plant's reduced water use—about a third less than a conventional coal-fired power plant with flue gas desulfurization.

"Although the Cool Water plant represents only one approach to GCC technology and presently has been fired on only one type of coal," said EEI's Kuhn, "we believe it offers significant insights into the potential of this technology to utilize many qualities of coal in environmentally acceptable ways in both new and retrofit situations." Illinois #6 and Pittsburgh #8 are scheduled for test runs later this year and early in 1986.



Electric Power Research Institute

Fluid bed feedwater pumps at the 20-MW Paducah plant supply water to the boiler to make steam.

While the Potomac Electric Power Company is contemplating its 360-MW gasification combined cycle power plant in Maryland, Virginia Power has proposed a similar project using a slagging Lurgi gasifier. Interest in this technology also has been expressed by the Cleveland Electric Illuminating Company and the Nevada Power Company.

Although gasification combined cycle seems to be a leading synthetic fuel technology, other synfuels processes may be applicable to utilities' special needs in the future. Coal liquefaction, for example, could provide a "hedge" against potential oil price hikes. Technologies such as the solvent refined coal process and the Exxon Donor Solvent process, which have been studied by government and industry since the early 1970s, could provide fuels for use in conventional oil-fired burners.

Advanced Coal-Based Systems

The use of coal can extend beyond the limits of combustion technology. Advanced processes can extract the energy from coal without the inherent environmental effects of fossil fuel burning. In fuel cells, for example, coal is first transformed to hydrogen-rich gas; then, instead of being burned, the gas is fed to a power section that extracts energy electrochemically. Research and demonstration will continue to develop fuel cells with different materials used as electrolytes, including phosphoric acid, molten carbonate, and solid oxide.

In an even more advanced technology, magnetohydrodynamics (MHD), coal's energy is converted to an extremely hot gas called a plasma. The plasma is "seeded" with potassium salts, both to improve its conductivity and to remove its sulfur content. The hot seeded gas moves at ultrasonic speed through a channel, which is surrounded by a very powerful magnetic field. Passing through the magnetic field, the hot gas generates electricity, which is tapped by electrodes in the channel wall. The hot gas gives up about 25 percent of its energy in this manner; some of the remaining energy can be recovered for use in a conventional steam turbine system. Such a system in commercial use could have an overall efficiency of about 50 percent.

Federal Help is Needed Now

These and other technologies currently under development could radically change the way that coal is used to provide reliable electric power. For these new technologies to have an environmental and economic impact soon enough, however, an accelerated commercialization program must begin immediately, according to EEI's Kuhn. "Clean coal technologies must be demonstrated at or near commercial scale before they will have the confidence of the electric utility industry and the agencies which regulate it," he said. "Federal participation could accelerate technology development, thereby assisting the U.S. economy with expanded and more efficient coal utilization." EP

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What Tax Reform Really Means

It's not just a political contest between "winners" and "losers."

President Reagan formally unveiled his long awaited plan to reform the federal tax code on May 28, 1985. Over the past several months, the plan has been subjected to close scrutiny by both the House Ways and Means Committee and the Senate Finance Committee. Legislative drafting is scheduled to begin by the middle of September or early October. Providing the Democratic-controlled House and Republican-controlled Senate can reach a compromise on several key issues, tax reform could become reality by the beginning of next year.

The stakes are high. The President's plan, which represents the most thorough overhaul of the tax system since World War II, is the centerpiece of the Administration's second-term economic agenda. Proposed changes in individual marginal tax rates, the maximum statutory corporate tax rate, depreciation schedules, and the investment tax credit, as well as other provisions, could determine the economic well-being of a number of industries for years to come. The emphasis on economic neutrality could alter the structural composition of American industry, facilitating the transition to a service- and high technology-oriented economy. Because of the far reaching consequences, tax reform will almost certainly be a focal point of political discussion at least through early 1986, an election year.

The Objectives of Tax Reform

The concept underlying the President's plan as well as most other proposals to reform the income tax is relatively straightforward. An expanded tax base is combined with substantially lower marginal and average tax rates, while maintaining the same level of government revenue.

While the concept is somewhat simple, the underlying objectives tend to be obscured by proposed changes in a number of specific provisions such as the research and development credit, accelerated depreciation, the deduction for state and local taxes, etc. The emphasis on particular provisions contributes, at least in part, to a misunderstanding of the overall purpose of tax reform. Contrary to a common perception, tax reform is not simply a political contest between potential "winners" and "losers," but rather is based on four fundamental social and economic objectives—capital formation, economic efficiency, equity, and simplicity.

Capital Formation

Capital formation is one of the principal determinants of economic growth. Broadly defined, it refers to the process of accumulating capital through the construction of plant, equipment, and housing; discovery and development of natural resources; research and development of new products and processes; and improvements in the education and skills of workers. By foregoing current consumption (saving) and investing in more productive forms of capital, a society provides for a higher standard of living in the future. Indeed, the relationship between capital formation and economic growth is clear: the larger the percentage of gross national product devoted to investment, the greater the economic growth rate.

Tax policy can promote capital formation through either investment incentives or saving incentives. Unfortunately, the current tax structure encourages dissaving (borrowing) as opposed to saving and often promotes the wrong type of investment.

Current incentives to promote domestic saving have been generally ineffective; the domestic rate of saving since the Individual Retirement Account went into effect in 1982 has averaged 5.8 percent, compared to a 6.6 percent rate of saving from 1975 to 1981. This does not imply, however, that domestic saving cannot be influenced by tax policy. The repeal of consumer interest deductions, either in full or the inflationary component, would reduce aggregate borrowing and, as a consequence, increase the pool of available saving. A significant reduction in the federal deficit would also increase the pool of saving available for investment.

Pro-saving incentives that increase the after-tax return on saving are essentially based on intuition and faith; the relationship between the rate of return on saving and the rate of saving is theoretically ambiguous and empirically inconclusive. Nevertheless, it

Mark Thomas is an energy analyst in the Energy Modeling and Economic Research Department at Edison Electric Institute.

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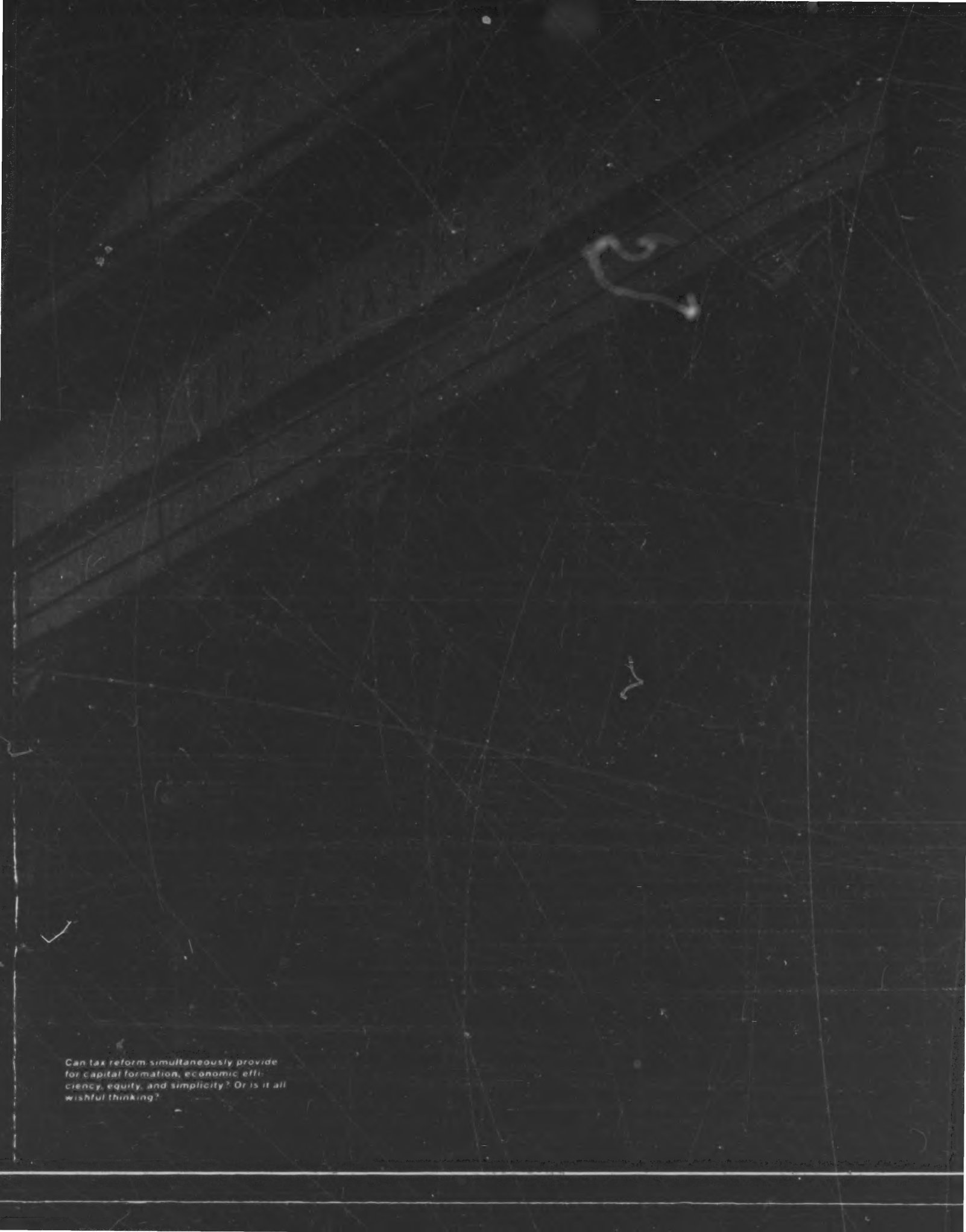


Can tax reform simultaneously provide for capital formation, economic efficiency, equity, and simplicity? Or is it all wishful thinking?

could be argued that the exclusion of saving from taxable income is justified since it improves the allocation of resources between present and future consumption.

A number of provisions have been introduced into the federal tax code in an effort to promote investment. The Investment Tax Credit (ITC), which was first adopted in 1962, provides corporations with a 6 to 10 percent first year write-off against the cost of new equipment. Accelerated depreciation methods were first adopted in 1954; in 1971, the Asset Depreciation Range (ADR) was adopted to encourage modernization of industrial capacity and to simplify administration. The Accelerated Cost Recovery System (ACRS) was adopted in 1981 to offset an escalating rate of inflation, enhance corporate cash flow, and reduce the after-tax cost of capital. The following year the Tax Equity and Fiscal Responsibility Act (TEFRA) modified the ACRS depreciation allowances planned for 1985 and 1986 and reduced the basis for cost recovery deductions by half the amount of the ITC.

Most investment incentives are conceptually similar; they reduce the after-tax cost of capital associated with a particular type of investment. Consider, for example, the difference between the present system of depreciation (ACRS) and the Real Cost Recovery System (RCRS), the depreciation system proposed by the Department of the Treasury in November 1984. On a discounted basis, the depreciation allowances under RCRS are on the order of 12 percent less than those allowed under ACRS. When coupled with the loss of the ITC, a 12 percent reduction in the present value of depreciation allowances would increase the after-tax cost of capital by 2.9 percent under a 46 percent statutory corporate tax rate. If RCRS and the loss of the ITC were coupled with a 33 percent tax rate as proposed under the original Treasury plan, the after-tax cost of capital would still rise by 1.4 percent.

While this may not seem substantial, a number of investments are only marginally profitable; several hundred basis points can and often do determine whether an investment project is undertaken. Moreover, when aggregated over the entire economy, relatively small changes in the after-tax cost of capital result in multi-billion-dollar changes in investment and economic activity. Finally, changes in investment tend to be cumulative over time; a higher level of investment generates a higher rate of economic growth, which generates a higher level of investment, and so on.

Practically every recent study conducted on the relationship between tax policy and investment is based on the Hall-Jorgenson formula for the price of capital. The formula equates the price of capital with a number of variables, including the present value of depreciation allowances for tax purposes, the investment tax credit, and the corporate tax rate. The equation yields two important results. First, an increase in the corporate tax rate increases the cost of capital, while an increase in the investment tax credit and the present value of depreciation allowances decreases the cost of capital. Second, an increase in the investment tax credit and the present value of depreciation allowances has a much greater impact on the cost of capital than a

The fate of the investment tax credit could affect many industries.

comparable reduction in the corporate tax rate.

The Hall-Jorgenson cost of capital has been used extensively in a number of econometric studies designed to estimate the impact and duration of tax policy on investment. However, such studies have reached different conclusions depending on the assumed duration of the effect and the theoretical relationship between capital and other inputs in the production process. Nevertheless, the qualitative results are the same—the elimination of the investment tax credit and a reduction in the present value of depreciation allowances, combined with a compensatory decrease in the corporate tax rate, reduce aggregate investment and, as a consequence, economic growth.

This latter point is especially significant since some of the tax reform proposals currently under consideration would eliminate the ITC and replace ACRS with a less generous depreciation schedule in exchange for a lower corporate tax rate. The loss of investment incentives has evoked considerable opposition from capital-intensive industries as well as some prominent economists.

Finally, it should be emphasized that tax policy should not be directed exclusively at investment. In the long run, a nation's level of investment is determined to a substantial degree by its available pool of saving. Public tax policy aimed at promoting business investment should thus be viewed as a complement rather than as a substitute for saving incentives.

Economic Efficiency

In the absence of noncompetitive markets, social externalities, institutional restraints, and government subsidies and taxation, a market economy will attain an optimal allocation of economic resources—optimal in the sense that no one can be made better off without making someone else worse off. Any departure from the optimum engenders a loss in economic efficiency. The magnitude of the loss depends on the degree of price distortion and the number and dollar value of the goods subject to distortion. In general, the greater the divergence from the market-determined relative price, the greater the loss in economic efficiency.

Unfortunately, the current tax structure encourages dissaving (borrowing) as opposed to saving and often promotes the wrong type of investment.

From the standpoint of economic efficiency, an ideal tax would only interfere with private decisions when social costs are not adequately reflected in market transactions. Apart from such considerations, an efficient tax would be neutral. It would not influence individual or business decisions on how income is earned or spent. It would not favor leisure over work, consumption over saving and investment, or one particular type of investment over another. It would neither encourage nor discourage risk-taking or the formation of new businesses. It would not grant special preferences to particular industries or to particular types of financial institutions. In short, an efficient tax would not alter the market-determined allocation of economic resources.

In practice, such a tax is neither politically nor administratively feasible. Nevertheless, public finance economists have identified a number of principles which would facilitate economic efficiency.

- *The income tax should avoid high marginal tax rates.* High marginal tax rates give rise to tax shelters and increase the incentive to reallocate saving away from heavily taxed investments into less heavily taxed or tax-free investments.

- *The income tax should not distort the choice between present and future consumption.* Under the current tax system, resources available for future consumption are taxed twice: first, on the original income stream and, second, on the interest earned on the income stream. Double taxation provides an incentive to increase consumption and reduce saving, a questionable policy given the deficient rate of capital formation.

- *The income tax should be fully indexed to offset purely nominal changes in income.* This requires that the standard deduction, the personal exemption, interest income and deductions, tax brackets, capital gains, and the value of inventory are automatically adjusted for inflation.

- *The tax system should not distinguish between different types of economic income.* Corporate income should be taxed at the same rate as noncorporate income, capital gains at the same rate as other types of taxable income, and physical capital at the same rate as human capital.

- *Dividends distributed to stockholders should be fully deductible.* Under the current corporate income tax, dividend earnings are taxed twice: once as corporate income and again upon distribution to shareholders as personal income. This has some unfavorable consequences. First, it distorts the allocation of capital by subjecting firms with comparable earnings to substantially different rates of taxa-

EDISON ELECTRIC INSTITUTE SUPPORTS PRESIDENT'S TAX REFORM PROPOSAL

In testimony before the House Ways and Means Committee on July 25, 1985, James J. O'Connor, Chairman, President, and Chief Executive Officer of Commonwealth Edison Company presented the views of Edison Electric Institute (EEI) on the President's tax proposal. The following is excerpted from his statements:

"EEI supports reform and simplification of the Internal Revenue Code to achieve fair and equitable individual and corporate taxation. However, it is important that our system of taxation continue to encourage economic growth. We therefore also support the objectives of the President's proposals that would retain capital-formation incentives, which are critical to the electric utility industry. The capital formation incentives contained in the Code, such as the investment tax credit and accelerated depreciation, provide a substantial portion of the capital needed for electric utility construction.

"Of the President's proposals, the repeal of the investment tax credit, the elimination of tax-exempt financing for private purposes, and the expiration of tax-deferred dividend reinvestment would have significant detrimental effects on capital formation for utilities. Although the overall effect of the President's proposals on our companies will be adverse because of our capital-intensive nature, the effect of these proposals on electricity customers generally is beneficial. Therefore, we support this tax reform package if the proposed Capital Cost Recovery System (CCRS), including normalization, is retained in substantially its present form and if reasonable transition rules are adopted for any repeal of the investment tax credit. In this latter regard, we are pleased, Mr. Chairman, that both you and Secretary Baker have agreed to develop appropriate 'grandfather' and transition rules for the investment tax credit.

"The electric utility industry is one of the most capital-intensive in the United States. On average, electric utilities need $2.74 of capital investment for every dollar of sales, whereas most other U.S. industries need less than $1.00 of capital investment for every dollar of sales. Since 1982, the trend has been to reduce the capital-formation incentives included in the Code. Unfortunately, the President's proposal would continue this trend.

"Despite the views expressed by some that electric utilities have surplus electric-generating capacity, we would urge this Committee to keep in mind that by 1993, using a moderate rate of growth in the demand for electricity of 2.5 percent annually, this country will have a need for a 28 percent increase in new generating capacity. To put this in perspective, this is about seven-and-a-half times the projected summer peak load for the State of New York for 1985. Further, capital requirements arise from the need for transmission and distribution facilities, which soon will constitute about 40 percent of the industry's construction expenditures.

"This clearly demonstrates that utilities must build to meet the demands placed upon the industry by their customers. Although conservation, load management, and the development of renewable energy resources have helped to reduce these demands, they are not sufficient to forego construction of new electric-generating capacity. If we as a nation were to experience gaps in the reliability of our electricity supply, the result would be a severe blow to our economic growth, with subsequent loss of jobs and income, and a weakening of the nation's competitive position in the world economy."

O'Connor went on to detail the industry's recommendations on certain specific parts of the President's plan.

Capital Cost Recovery System

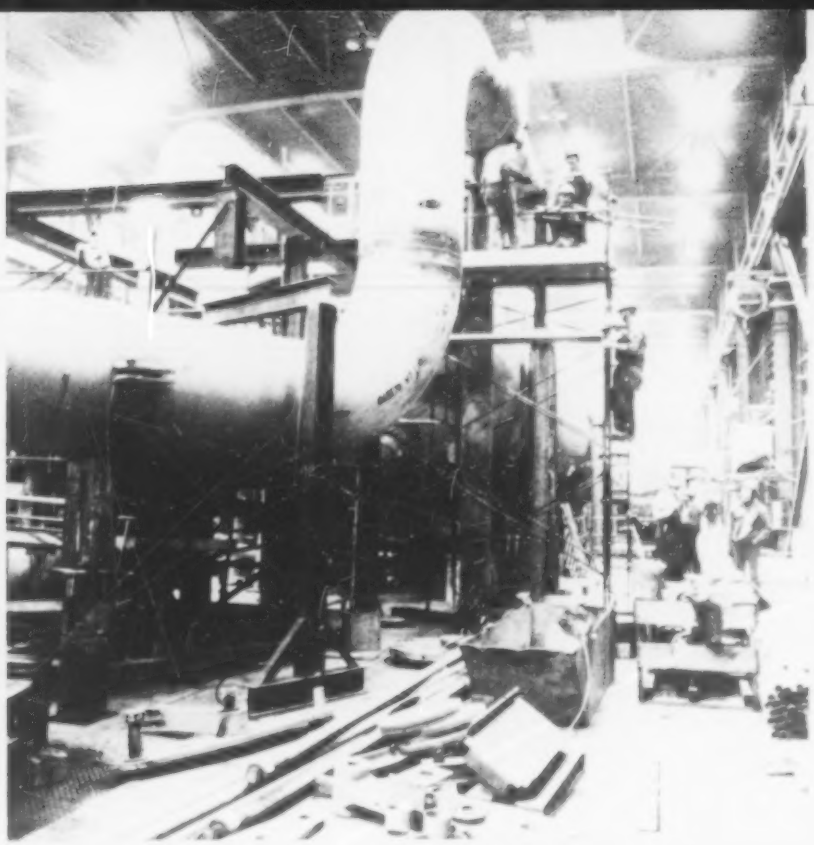
"EEI supports the concept in CCRS of neutral investment incentives for equipment of all industries. This concept is consistent with the theme in the President's tax reform package that a 'level playing field' is intended for investments for all taxpayers. In the past, electric utility property too often has been singled out for disproportionately long recovery periods. This long-standing, unjustified disparity presumably would be corrected under CCRS as proposed.

"Under CCRS, all depreciable assets would be categorized in one of six classes, with assets in each class having similar economic depreciation periods. A level playing field would be more nearly created by providing equal economic treatment for all property in classes one through five. As explained in the President's proposals, the recognition of inflation by indexing capital assets is essential to attain economic neutrality. We commend this approach. The electric utility industry nevertheless would pay a high price under the President's proposals because CCRS would not provide capital equal to that of the combination of ACRS and the investment tax credit. Therefore, if the present inclusion of electric utility property in class five under CCRS were to be changed to inclusion in a class with a longer recovery period, then our industry would be even more severely disadvantaged, and the playing field would become so 'unleveled' that we could not support the President's proposals."

Normalization

"The benefits to the electric utility industry under CCRS would contribute to capital formation *only if* such benefits are normalized consistent with rules in existing law and in the President's proposals." [Normalization is the process by which tax benefits are evenly spread out to consumers over the life of an asset.] "Normalization allows electric utilities to compete on a more level playing field with other providers of energy and in the capital markets. Normalization therefore should be treated as part of the concept of investment neutrality.

"We are pleased that the President recognizes the need for normalization provisions similar to those in present law. Regulated companies should be re-



Electric utilities depend on capital formation incentives in the tax code to help finance construction to meet future power demand.

quired to normalize the tax effect of the timing difference between CCRS depreciation without inflation adjustments and straight-line depreciation of the tax basis of property using lives prescribed for financial accounting and ratemaking purposes. . . . Further, regulated companies also should be required to normalize the tax effect of depreciation differences that would be attributable to CCRS inflation adjustments. . . . Inflation indexing can also be thought of as supplanting, in part, the investment tax credit. Appropriately, therefore, the effect of depreciation of inflation adjustments should be required to be ratably flowed back by regulated companies over the life of the related asset in a manner similar to the treatment prescribed under current law for regulated companies for the investment tax credit. . . . If the normalization requirement were violated, then regulated companies should not be permitted to use CCRS depreciation. Normalization would assure a sharing of the benefits of CCRS between a utility's present customers and its future customers."

Investment Tax Credit

"The repeal of the investment tax credit would be particularly detrimental to the electric utility industry. The credit has provided an important source of capital to help finance the construction of needed electric-generating facilities and transmission and distribution facilities. A loss of the credit would require significant increases in external financing.

"If the investment tax credit is to be repealed, several aspects related to the repeal need to be addressed. Our major concerns are the absence of transition provisions, the regulatory treatment of unamortized credits, and the ability to utilize credits unused as of December 31, 1985."

O'Connor continued by saying that utility property should be covered by ITC transition rules if construction has begun or a binding contract has been entered into. This will protect utilities that made decisions to construct equipment or are continuing construction based on current rules. Similar rules were enacted in 1969 when the credit was last repealed.

Under present law, unused investment tax credits can be carried over to future taxable years. These unused credits should remain available even if the credit is repealed.

O'Connor noted other proposals in the President's tax reform package that must also be examined, including:

- The provision to tax so-called excess depreciation, with respect to assets having 10- and 15-year recovery periods, is unduly harsh. If this provision is enacted, more equitable treatment would be payment of the taxes over the life of the asset or 10 years, whichever is shorter.

- In capitalizing construction period interest, the definition assumes that 100 percent of construction is financed by borrowed funds. Regulatory constraints require utility construction to be financed through both debt and equity financing; therefore only the debt portion of construction should be capitalized under the proposal.

- The alternative minimum tax should not hurt those companies that have unused investment tax credits that have accumulated under present law, as these are the companies usually least able to afford the tax. Therefore, the credits that would be allowed against the regular tax should be allowed as a credit against the alternative minimum tax.

- The dividends-paid deduction is an attempt to reduce the multiple taxation of corporate earnings. For electric utilities, it is reasonable to assume that regulators would use the reduced tax liability resulting from the dividends-paid deduction to lower rates for electric service by allocating the benefits to ratepayers and not to shareholders. A more efficient approach would be to provide this as a credit or deduction at the shareholder level.

- Proposals affecting employee benefits would hamper efforts to provide adequate retirement funds through private plans, and extensive changes would be unfair to employees who made investment and saving decisions based on current law. In addition, taxing health care benefits could discourage participation in private programs, resulting in greater burdens on publicly-funded efforts.

tion. Second, the relative advantage afforded debt financing penalizes small and risky firms which depend heavily on equity financing. Finally, the tax-induced reliance on debt financing undermines the financial health of U.S. corporations, contributing to uncertainty and risk, low interest coverage ratios, low bond ratings, and high interest rates.

- *The marginal effective tax wedge* (the difference between the pre-tax rate of return and the after-tax rate of return on new investment) *and marginal effective tax rates* (the marginal effective tax wedge divided by the rate of return) *for all assets and industries should be equivalent.* Differential tax treatment can cause two types of misallocation. First, intra-industry distortion results from a disparity in tax rates on investment within an industry. Second, inter-industry distortion results from a disparity in tax rates across industries.

- *The tax base should be significantly expanded.* Preferential tax treatment distorts market decisions and induces investment in areas that are otherwise unprofitable. The repeal of preferential provisions would tend to equalize effective tax rates and permit a compensatory reduction in individual and corporate income tax rates.

Unphoto

The personal income tax is a convoluted maze with thousands of provisions. Simplifying the tax system would go far to improve taxpayer morale, not to mention tax compliance.

Equity

An equitable tax should fall equally on taxpayers of similar economic status (horizontal equity) and should distinguish between taxpayers of different economic status (vertical equity).

Horizontal equity requires that individuals (or households) with the same economic income and circumstances bear the same tax burden. This is not always the case under the current system. Numerous deductions and allowances afford some individuals a relative tax advantage over other individuals with the same income. The ability to pay should also be taken into consideration, since unusual circumstances such as excessive medical expenses may impose a financial hardship which is not reflected in economic income. At the very least, a properly designed tax system should assure that individuals with the same income and circumstances pay the same tax.

Vertical equity has been a fundamental characteristic of tax policy since the inception of the income tax. Progressivity can be achieved through either incremental increases in the tax rate or by excluding some minimum level of income from taxation. Although both approaches are conceptually similar, exclusionary deductions such as the personal exemption and the zero bracket amount provide greater tax relief for the poor than a highly progressive tax rate schedule. More importantly, from the standpoint of overall policy, exclusionary deductions, unlike high marginal tax rates, do not distort the allocation of economic resources.

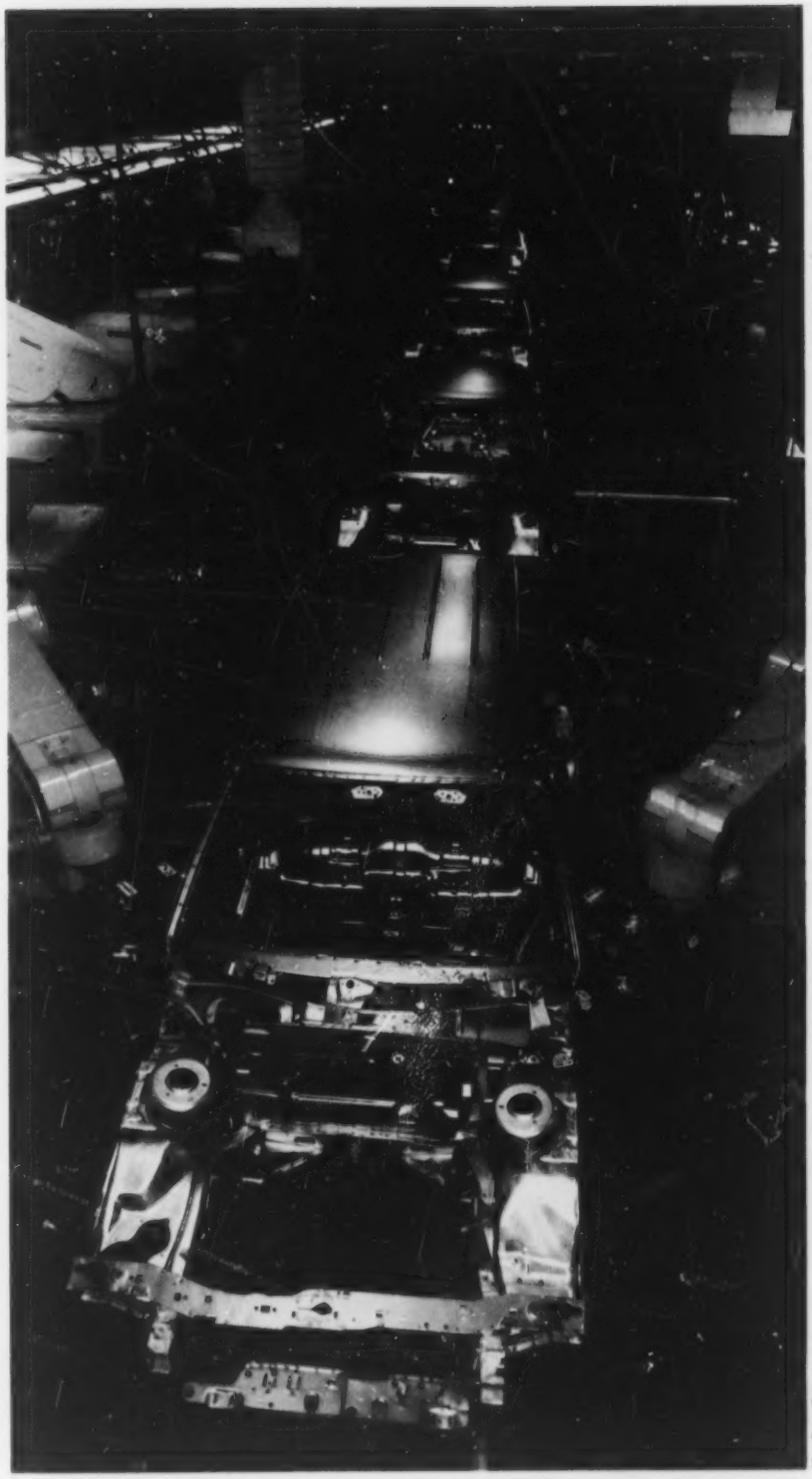
Although the relative progres-

siveness of a tax system is primarily a normative issue, it has economic ramifications. Since higher income groups save on average a higher percentage of their income, there is a trade-off between progressive taxation and the rate of saving. One possible way to resolve this problem is to exclude savings from taxable income. Another possibility would be to distinguish between income from saving and income from other sources, with each source taxed at different progressive rates after excluding a specified amount. Both methods would allow for a progressive tax structure which is compatible with saving incentives.

Simplicity

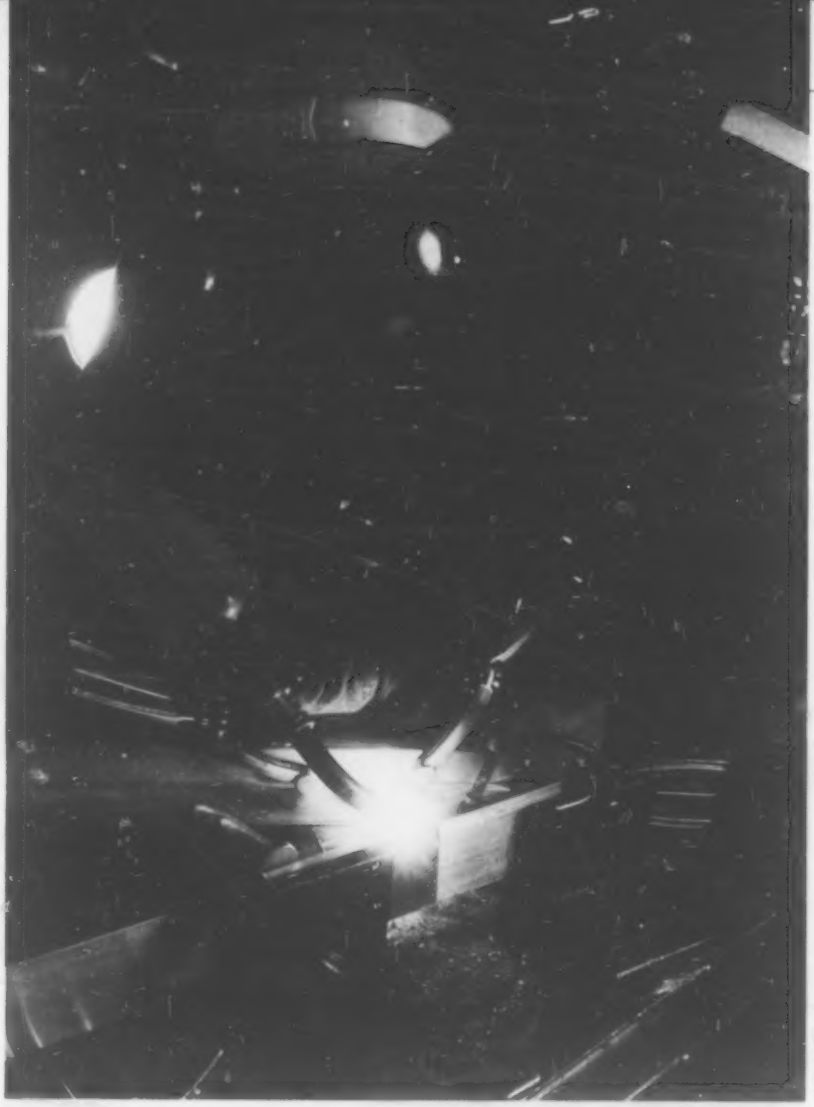
Tax simplification has been recommended in numerous studies and legislative hearings dealing with tax policy. Nevertheless, the income tax has become an increasingly complicated accretion of preferential provisions. As a result, the income tax is a convoluted maze. *Bender's Dictionary of 1040 Deductions* lists close to 2,000 credits, deductions, exclusions, deferrals, and individual preferences on Schedules A through F of the personal income tax; in addition, hundreds of other provisions are listed for partnerships, estates, trusts, and corporations. The tax code obviously needs to be simplified.

Tax simplification would have a number of benefits. First, it would stimulate the formation of new business. The administrative complexity of the current tax system stifles entrepreneurial initiative. Many new businesspeople are not familiar with the tax provisions



Mark Ferri, Ford, Inc.

The President's tax plan emphasizes economic neutrality, which could alter the structural composition of American industry.



The tax-induced reliance on debt financing undermines the financial health of U.S. corporations, contributing to uncertainty and risk, low interest coverage ratios, low bond ratings, and high interest rates.

pertinent to their firms, nor can they afford expensive outside expertise. Furthermore, a complicated tax system represents a psychological barrier to the aspiring but inexperienced entrepreneur.

Second, simplification would reduce, perhaps substantially, the time and money spent on compliance. It has been estimated that taxpayers spend over $1 billion annually on professional assistance on tax returns; the federal government devotes over 400 million hours to tax reporting. This results in a tremendous loss of resources which could otherwise be used in more productive activities.

Third, tax simplification would improve tax compliance. The Internal Revenue Service estimates that $100 billion is lost annually through tax evasion. Another extensive study on the subject suggests that the figure may be closer to $200 billion. Regardless of the amount, a simplified tax system would allow the government to reduce its administrative costs and focus its resources on enforcement.

Finally, a simplified tax system would improve "taxpayer morale." The federal income tax is primarily a voluntary tax system; it depends on the honesty of the average American to finance government activities. Voluntary compliance is undermined by a growing belief that others are able to avoid taxation through a vast array of esoteric provisions. Simplification would help to restore the public's confidence in the U.S. tax system.

A Comprehensive Income Tax

As suggested in the foregoing discussion, a well-designed tax system should be efficient, equitable, simple, and favorable to economic growth. Although the current tax system addresses equity and economic growth, it is woefully inefficient and complex. More importantly, the tax system is largely comprised of piecemeal additions and modifications. Until recently, tax policy was seldom if ever motivated by a single coherent objective. The current income tax is, with few exceptions, simply a hodgepodge of well-intentioned, but narrowly focused, provisions. Despite the relative merits of specific provisions, each successive departure from a uniform broad-based tax violates the principle that people with the same income should pay the same tax and imposes higher average and marginal tax rates on a smaller tax base.

One possible solution is to repeal many of the current deductions, credits, exclusions, and preferential tax rates. This is the concept underlying a broad-based comprehensive income tax. In its pure form, a comprehensive tax base would be comprised of every element of consumption and any change in an individual's net worth. This would include earnings, investment returns from realized and unrealized capital gains, gifts, bequests, imputed rent from owner-occupied housing, and transfer payments. In practice, however, it would be exceedingly difficult to account for unrealized appreciation on assets or noncash transactions.

Although a pure comprehensive income tax is neither politically feasible nor practically possible, there are a number of ways to expand the tax base.

A bill sponsored by Senator Bill Bradley (D-N.J.) and Representative Richard Gephardt (D-Mo.), for example, would repeal or curtail a wide range of individual and corporate provisions, while retaining a number of socially desirable or politically palatable provisions such as deductions for state and local income and property taxes, charitable contributions, the Individual Retirement Account and Keogh plans, and interest on general obligation bonds. Bradley-Gephardt would also retain exemptions for workers' compensation, veterans' benefits, and social security benefits for low- and moderate-income individuals.

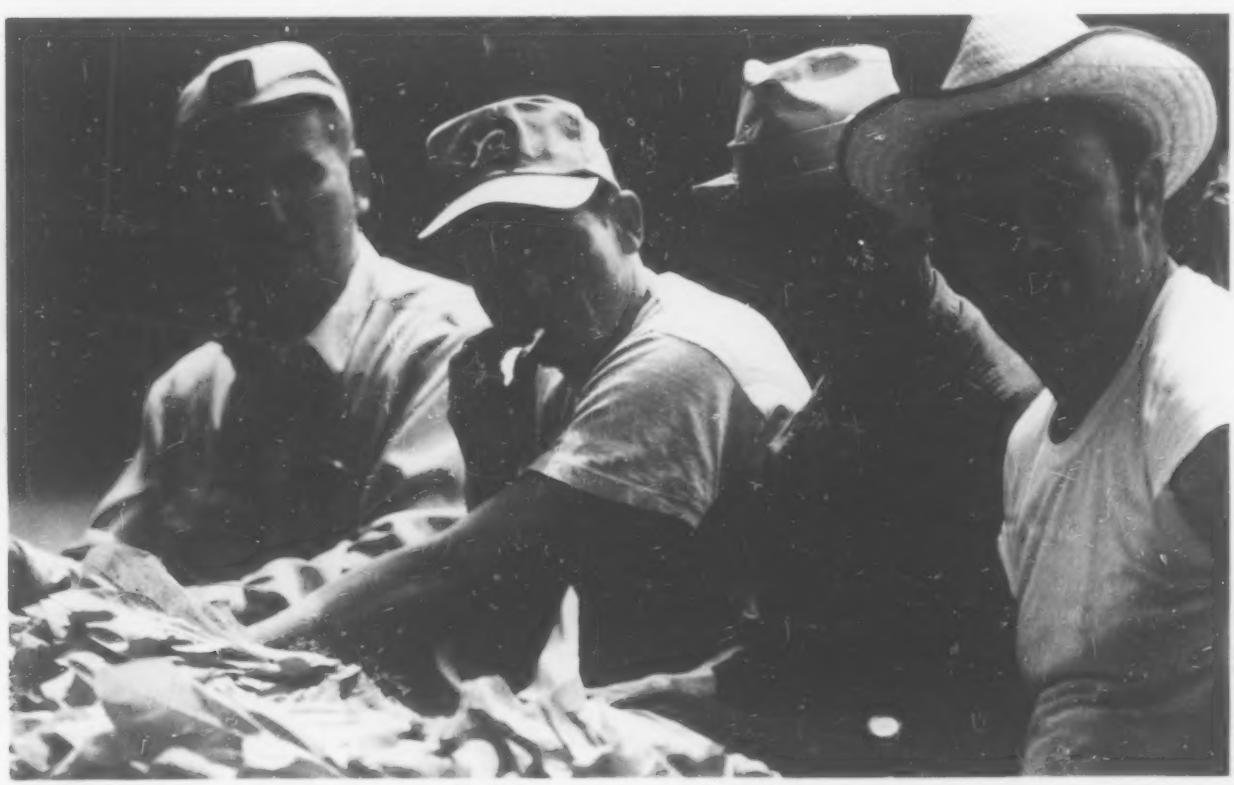
An alternative version has been sponsored by Representative Jack Kemp (R-N.Y.) and Senator Bob Kasten (R-Wis.). Kemp-Kasten repeals the deduction for state and local income taxes as well as a number of other provisions, but retains preferential treatment of capital gains, the deduction for interest on educational loans, percentage depletion, and the intangible drilling cost deduction.

A third possible version, proposed by President Reagan, repeals or curtails a wide range of provisions including the deduction for property taxes, but provides a 10 percent deduction on dividends paid.

All three proposals would retain a number of popular provisions, including deductions for home mortgage interest, excessive medical expenses, charitable contributions, and the Individual Retirement Account. Although other versions could allow for still further deductions, they would depart from the concept of a comprehensive income tax.

A comprehensive tax has several important advantages over the present tax system. First, it is considered more equitable. Tax experts have observed that higher income groups benefit disproportionately more, on average, than others from the current array of tax provisions. Indeed, the Treasury Department estimates that the top 4.4 percent of taxpayers in

Labor-intensive and research-intensive industries are less dependent on capital formation incentives than are capital-intensive industries.



Charles Gupton/Uniphoto

Under the present corporate tax system, dividends are taxed twice—once as corporate income and again upon distribution to stockholders as personal income.

1981 (those making $50,000 or more) received disproportionately greater benefits from 13 out of the 33 tax provisions considered. Moreover, the Treasury found that individuals making $100,000 or more (less than one percent of all taxpayers) received 13 percent of the benefits. Studies conducted by the Treasury Department, the Congressional Budget Office, and the Joint Committee on Taxation led these entities to conclude that the elimination of these and other regressive provisions would improve the relationship between taxation and the ability to pay.

Second, a comprehensive income tax would reduce complexity. Between 1967 and 1985, the number of provisions, including tax credits, preferential rates, special exclusions and deductions, and deferrals of tax liability, more than doubled. Over the same period, the cost of tax expenditures defined as provisions that depart from the normal tax structure rose from $37 billion to $365 billion.[1] The elimination of a large number of these provisions would substantially simplify the tax system.

Third, an expanded tax base is likely to reduce noncompliance. A large and growing number of provisions have made tax enforcement more difficult; evidence indicates that exaggerated deductions, unreported income, and unfiled returns are all increasing faster than personal income. A comprehensive income tax should help to reverse this trend and allow the government to concentrate on the most egregious types of tax evasion.

Fourth, to the extent that a comprehensive income tax reduces the differential taxation of economic income, it improves allocative efficiency. A fundamental tenet of economic theory is that an unfettered market economy results in an efficient allocation of economic resources. Governmental intrusion in the form of preferential tax treatment distorts market decisions and channels investment into areas that are otherwise unprofitable. The repeal of preferential provisions would tend to equalize effective tax rates across industries. This would reduce the efficiency loss resulting from inappropriate investment and improve economic growth by ensuring that scarce credit is allocated to the most efficient and productive sectors of the economy.

Finally, a comprehensive income tax makes it possible to reduce tax rates while maintaining the same level of government revenue. It has been estimated that tax rates under a fully comprehensive income tax could be reduced by at least 40 percent without changing the amount of revenue collected. This has important economic implications. Lower marginal tax rates would curtail the use of tax shelters; reduce the tax-motivated bias towards debt financing, capital gains, owner-occupied housing, commercial construction, etc.; and increase labor force participation and productivity. All of this could be accomplished while maintaining the same degree of progressivity.

Some Difficult Choices

The four objectives of tax reform are not fully compatible. A well-designed tax system thus requires some difficult choices. It may be necessary, for example, to choose between a flat-rate tax—arguably the most efficient type of income tax—and vertical equity, or between saving incentives on the one hand and horizontal equity and simplicity on the other. A tax on all economic income would be extremely complex, while the exclusion of saving from taxable income would be particularly unfair to

SPECIAL PROBLEMS OF TAXING INCOME FROM CAPITAL

One especially troublesome problem with the present tax system is the taxation of capital income. The present tax system, with some exceptions, taxes both saving and the income from savings, which increases the price of future consumption relative to current consumption. This reduces current saving and investment relative to the amount that would be saved and invested if taxes were levied only on consumption. Many of the changes in the Federal tax system during the past several decades represent selective measures to reduce the bias against saving and investment. Such changes include limited exclusions of retirement saving and measures to reduce effective tax rates on the income from new investment. The Economic Recovery Tax Act of 1981 further reduced the bias against saving and business investment, most importantly by extending the individual retirement accounts (IRAs) to employees and accelerating cost recovery on business investment. These measures have contributed to the rapid rate of domestic business investment, but they do not appear to have increased the personal saving rate. The substantial remaining bias against saving and investment should be a major focus of future changes in the tax structure.

The current tax system also distorts the pattern of investment spending, because the effective tax rate on new investment depends on the type of asset and the rate of inflation. These distortions have arisen partially because capital income is difficult to measure. For example, to calculate net income it is necessary to deduct the expenses incurred in earning that income, a critical component of which is the depreciation of the capital asset. Unfortunately, "economic depreciation," a concept that measures changes in value arising from both physical deterioration and obsolescence, is extremely difficult to measure accurately.

Another problem is that the tax system is not completely indexed for inflation. Although individual income tax brackets are being adjusted annually for inflation, taxation of capital income is still affected by the inflation rate. Depreciation allowances fall in real value as the price level rises, leading to an overstatement of the real income of businesses. Increases in the value of inventories solely because of inflation may also increase taxable income. Finally, increases in the value of capital assets that merely reflect the increased price level are subject to a capital gains tax upon sale.

Several of the changes in the tax law during the past decade have been advocated as offsets to the unintended effects of inflation on effective tax rates. These changes include the reduction in the taxation of capital gains in 1978 and the accelerated cost recovery system of the Economic Recovery Tax Act of 1981. Although these tax changes reduced the average rate of taxation on the income from new investment, they did not successfully deal with the problem that the effective tax rate varies widely depending on the type of investment and the financing method.

Nonuniform taxation of capital income causes misallocation of capital. One estimate of the cost of this misallocation of corporate capital is that it is equivalent to wasting 1½ percent of the present stock of capital, or more than $5 billion worth of output annually.

Another important feature of the present tax system is the presence of a separate tax on corporate income. There is no necessary role for a separate corporate income tax in a pure income tax system. The income generated by corporations could be directly attributed to stockholders and taxed under the individual income tax system in the way that partnership income is treated. The primary justification for a separate corporate tax is to ensure that retained corporate income is subject to tax. However, the corporate income tax achieves this end only at the cost of introducing a number of distortions to economic behavior. Corporate earnings distributed as dividends are taxed more heavily than other forms of capital income because they are subject first to the corporation income tax and then to the individual income tax. Earnings retained by the corporation may be overtaxed relative to noncorporate business income if the corporate tax rate is greater than the shareholder's marginal individual income tax rate. Thus, the present system can impose a higher effective tax rate on activities carried out by corporations compared with activities performed outside of the corporate sector.

Because interest payments are deductible while dividend payments to shareholders are not, the corporation income tax system provides an incentive to use debt rather than equity financing. This leads to more debt finance than the market would otherwise choose, increasing the vulnerability of corporations to bankruptcy. Because earnings paid out as dividends are taxed more heavily than earnings retained within the corporation, there is a tax incentive for corporations to retain earnings. This may lead to inefficient investment of retained earnings at rates of return lower than those available to the stockholder.

Excerpted from the *Economic Report of the President*, Transmitted to the Congress, February 1985, together with *The Annual Report of the Council of Economic Advisers*, United States Government Printing Office, Washington: 1985.

older individuals who deplete their lifetime savings during retirement. Deductions for excessive medical expenses or the childcare credit affect the ability to pay even if such provisions do not affect economic income.

While the dilemma posed by such choices can be resolved without substantially departing from the overall concept of tax reform, several trade-offs pose an especially troublesome problem. For example, the elimination of the capital gains exclusion coupled with inflation indexing would promote horizontal and vertical equity, improve allocative efficiency, and greatly reduce administrative complexity. It has been argued, however, that the elimination of the exclusionary provision would completely decimate the venture capital financing industry. One possible solution is to provide a special exclusion for venture capitalists. Unfortunately, such an exclusion is arbitrary at best and difficult to enforce.

The proposed elimination of the deduction for state and local income taxes also presents a problem. While the deduction primarily benefits higher income groups, state and local tax revenue is often used to fund social services for the poor. The improvement in equity at the federal level thus may be offset by the inequitable hardship imposed at the local level. Moreover, the per capita cost of governing large metropolitan areas is substantially greater than that of governing small cities or rural areas. Finally, a distinction could be made between the deduction for state and local income taxes and the deduction for property taxes, since property taxes are used primarily to fund public education. Congressman Kemp, for instance, argues that public education represents an investment in human capital and, as such, deserves the same type of treatment as other types of investment.

Finally, it has been argued that the objectives of economic efficiency and capital formation are inconsistent. Although this contention is not without merit, these two objectives can be substantially reconciled, providing other considerations such as equity and simplicity are not given first priority. For example, the full or partial expensing of dividends paid would eliminate the current bias towards debt financing, reduce intra- and inter-industry distortion, improve corporate balance sheets, and reduce the weighted after-tax cost of capital.

Similarly, investment incentives can be easily reconciled with at least one type of efficiency criteria—intra-industry neutrality. Since this criterion simply requires that marginal tax rates on different types of investment be equivalent, tax policy could be very favorable toward capital formation, even to the point of expensing new investment, without significantly distorting resource allocation among different types of investment. This is the concept underlying the Kemp-Kasten "neutral cost recovery system," which provides the present value of investment ex-

Proposed changes in the corporate tax rate and depreciation schedules can affect investment decisions.

pensing without distorting inter-asset investment.

The President also adopted this approach in his proposal. The Capital Cost Recovery System (CCRS) would lengthen recovery periods from the current range of 3 to 18 years to a range of 4 to 28 years. This change would appear to be detrimental to industry. However, according to Treasury estimates, the present value of depreciation allowances under CCRS is greater than that allowed under ACRS.[2] Moreover, CCRS would substantially reduce the variance in effective tax rates across different assets. Finally, the unrecovered portion of an asset's cost would be adjusted for inflation each year.

Reconciling inter-industry neutrality and investment incentives, on the other hand, is a much more difficult task. Since labor- and/or research-intensive industries benefit less from capital formation incentives than do capital-intensive industries, the greater the investment incentives the greater the disparity in inter-industry effective tax rates. This problem can be overcome to some extent by treating both human capital (i.e., higher education, vocational school training, on-the-job training, etc.) and research and development as types of investment; that is, expenditures for such cost would be eligible for tax depreciation. Finally, inter-industry distortion could be further reduced through the expensing of dividend deductions and an across-the-board reduction in the statutory corporate tax rate.

From an overall perspective, the objectives of tax reform are generally consistent. The elimination or curtailment of existing provisions would promote capital formation (through a lower corporate tax rate and favorable depreciation allowances), improve efficiency, promote equity, and simplify the tax code. Other provisions, however, are not easily reconcilable with the goals of tax reform and require some difficult choices; for example, it may be necessary to retain capital formation incentives even if they give rise to differential effective tax rates. Such exceptions notwithstanding, the elimination of deductions, credits, exclusions, etc., coupled with lower average and marginal tax rates, has become an appealing idea; for in addition to lowering the tax liability for a majority of American taxpayers, a comprehensive income tax reconciles four seemingly opposing objectives—capital formation, efficiency, equity, and simplicity.

When asked in 1982 what he thought the chances were that a broad-based, flat-rate tax would be enacted, . . . Milton Friedman responded, "Zero."

An Idea Whose Time Has Come

Genuine tax reform should not be considered a certainty. The tax code consists of a bewildering array of deductions, credits, exclusions, preferential tax rates, and provisions to offset and defer tax liability. A thorough overhaul of the tax system represents a monumental undertaking. Moreover, a number of important issues have yet to be resolved, including the deduction for state and local taxes, preferential provisions for the oil and gas industry, preferential treatment of capital gains, and the system of depreciation. Finally, a proposal which is politically palatable to both the President and Congress must be developed before popular support wanes.

The obstacles to tax reform should not be underestimated. When asked in 1982 what he thought the chances are that a broad-based, flat-rate tax would be enacted, the Nobel Prize-winning economist, Milton Friedman, responded, "Zero."[3]

In spite of the obstacles, tax reform appears to be an idea whose time has come. Public opinion polls invariably report dissatisfaction with the current tax system. This disfavor lends support to a number of recently developed broad-based approaches to tax reform. Although the tax rate, the number and types of deductions, and the overall emphasis may vary, these approaches are comparable in that they substantially reduce marginal and average tax rates and eliminate and curtail numerous individual and corporate provisions.

Recognition of a problem and proposals designed to overcome it, however, do not constitute a solution, since even the proponents of tax reform disagree on a number of important issues. Nevertheless, presidential sponsorship and bipartisan support in both houses of Congress augur well for true tax reform. EP

Notes

1. *Federal Tax Expenditures for Fiscal Years 1984-1989*, Joint Committee on Taxation, 1984.

2. The Treasury compared the present discounted value of CCRS, ACRS, and straight-line depreciation methods on the basis of comparable asset classes and three different rates of inflation. Assuming a 5 percent inflation rate and a 4 percent real rate of return, the present discounted value of CCRS allowances exceeded that allowed under ACRS for all comparable asset classes. However, at a zero rate of inflation ACRS is more favorable than CCRS in four of the six asset classes. At a 10 percent rate of inflation CCRS is much more favorable than ACRS in all six asset classes. Finally, it should be noted that the Treasury did not consider the loss of the ITC in these estimates.

3. Richard L. Kirkland, Jr. "The Flatter Tax Movement Picks Up Steam," *Fortune*, July 26, 1982, p. 34.

Drugs at Work

The business world is grappling with growing alcoholism and drug abuse among employees.

Frank W. grew up in New York City and, like many urban kids, was raised around drugs. When he began working for a Sunbelt utility after a stint in the Navy, he found that smoking a little dope made his shift more pleasant.

Frank is not alone. Alcohol and now drug abuse on the job have become a major challenge for employee management. As *Newsweek* magazine notes, "Joint by joint, line by line, pill by pill, the use of illegal drugs on the job has become a crisis for American business."[1]

Addiction to drugs and alcohol is on the rise in the nation's corporations. A Denver attorney snorts cocaine through a hollowed-out pen. There's the case of a California bus driver who used amphetamines regularly during all-night runs. "Everybody did," he says.

Stock and bond traders on the floor of the New York Stock Exchange sneak out for pills. Brokers at their desks race through their hundred-plus telephone calls a day with the aid of drugs. *Fortune* magazine tells the story of a successful 43-year-old commodities trader. His addiction to cocaine led to fierce paranoia. One night, he imagined his house was surrounded by police officers. He convinced himself that if he stripped naked and climbed out the window, he would be invisible to them and escape. He walked five miles during early morning rush hour traffic down the divider strip of a Long Island freeway before police took him into custody.[2]

In the electronics industry, where top executives are often less than 35 years old, drug use is allegedly widespread.

Nurses and doctors, with easy access to supplies of drugs, have also succumbed. As many as 4 percent of Chicago doctors are addicts, according to one study, a rate nearly double the national average.[3]

Police officers are users. In 1983, the District of Columbia dismissed 35 officers, some of them five-year veterans, for suspected drug use.

Alcohol has long been a problem in the American workplace. Why the apparent drug epidemic? Simply enough, the generation that began in the mid-1960s to explore new mental horizons on the wings of "recreational" drugs has entered the workforce. And habits die hard. What's more, the new generation of career-conscious students is not necessarily shunning drugs and alcohol. It's certainly no secret that teenage alcoholism is rising. And with the price of cocaine declining, that drug is becoming accessible to a greater number of people.

Exactly how deep the problem runs is unclear. It doesn't lend itself to a telephone poll. Drug users and alcoholics alike hide their problems. "Denial is the hallmark of drug dependency," points out Dr. Joe Mattox, a psychologist and the administrator of the employee assistance program at Pacific Gas and Electric Company. Numbers are guesses.

Those responsible for dealing with the situation on the worksite begin with what is perhaps a conservative measurement: 10 percent of the job force are alcoholics, 5 percent do drugs.

Bartlett Naylor is a journalist specializing in business and financial issues.

Some estimates show the figure lower, others even higher.

The National Institute on Drug Abuse says there are as many as five million regular cocaine users. That alone is 2 percent of the population—and nearly 5 percent of the workforce.[4]

"For any company to say there is no problem would be incorrect," says David E. Lewis, manager of supervisory training and responsible for helping establish the employee assistance program at the Nevada Power Company.

And so the electric utility industry and virtually all of corporate America have decided to address drug and alcohol abuse on the job.

Although corporate responsibility is certainly one justification for employee assistance programs, there are other motives. "Healthy employees and those programs that promote their health can help reduce the trend toward ever increasing health benefit costs, absenteeism, and decreased productivity," writes Dr. Charles A. Berry, former chief medical director of the U.S. space program, in a publication of the National Institutes of Health.[5]

"We don't like to lose the investment we have in a regular employee," says Lewis of Nevada Power.

Alcoholics and drug abusers drop things, they run their vehicles into walls, they drop lighted matches on flammable materials, they fail to interpret meters properly, they forget to perform assigned tasks.

Addicts can be thieves. Paychecks often aren't enough to cover a cocaine habit. The worksite can

As much as 5 percent of the workforce may use cocaine. Is there a drug epidemic in corporate America?

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		IRA-910	IRA-94
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Romicon® Ultrafiltration Cartridges

Model	Membrane* Area	Cartridge Length
HF132-20-GM80	132 sq. ft.	43 inches
HF73-20-GM80	73 sq. ft.	25 inches
HF53-20-GM80	53 sq. ft.	43 inches
HF30-20-GM80	30 sq. ft.	25 inches

*Average membrane pore size: 40-50Å (~0.005μ)

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Dave Schaefer Unphoto

Taking refuge in alcohol, marijuana, cocaine, amphetamines, heroin or other drugs is one way people try to cope with personal problems.

become a source of supplies and equipment that can be stolen and sold for cash—cash used to buy drugs.

Abusers incur higher medical bills, since the drugs erode organs of the body. And accident proneness can lead to damage at the company and also to disabilities. The financial settlement for a disability is a direct cost to the firm.

The costs to American industry of alcohol abuse have been studied longer than the costs of drug abuse. Through the 1970s, for example, the economic costs of alcohol abuse grew from an estimated $30 billion in 1971 to $43 billion by 1975. In 1983, as much as $92 billion was lost because of the problem, according to studies reported by Dr. J. Michael Swint in a publication of the Department of Health and Human Services.[1]

According to Dr. Swint, a professor of economics at the University of Texas Health Science Center in Houston, drug and alcohol abusers have a higher turnover rate. That's due to death or to voluntary or involuntary termination.

Dr. Swint points to the need for a corporate response: "The evidence is clear that successful rehabilitation . . . produces substantial benefits to the firm."

Utility executives probably subscribe to this sentiment currently. But it was not always so.

Says Edward Bomsey, manager of employee relations at the Edison Electric Institute, "The problem was initially perceived by business as an exclusively large urban one. There might be problems in Chicago, New York or Los Angeles, but not in Iowa or Utah. And then there's been the problem of covering up. In the old days, where there was a senior employee with an alcohol problem, people would cover up for him. Keep him going so he could make it to a pension, thinking they were helping him. But now people are realizing that drug and alcohol abuse is widespread. They are also learning that allowing the continuing physical and mental harm to the employee caused by substance abuse is definitely not in his or her best interest. Covering up can kill."

In the electric utility industry, there are identifiable leaders in pioneering company substance abuse policies and programs. Georgia Power Company stands out. So do Commonwealth Edison in Chicago, Public Service Electric and Gas in New Jersey, Southern California Edison, and Boston Edison, among others.

Although few efforts can be considered old and established, there is enough experience for the Edison Electric Institute to have published a revision to its 1983 *EEI Guide to Effective Drug and Alcohol*

Policy Development.

Its manifesto is simple: "The electric utility industry recognizes the prevalent use of drugs and alcohol in the United States and the need to provide a drug-free work environment in the interest of employee and public health and safety."

The purpose of the new *EEI Guide to Effective Drug and Alcohol Fitness for Duty Policy Development* is to "assist companies in developing their own alcohol and drug policies or programs if such programs do not currently exist or might benefit from expansion."

The EEI guide contains 10 key program elements:

- Written policy,
- Effective policy communication,
- Behavior observation training for supervisors,
- Policy guidelines and training for supervisors,
- Employee assistance programs,
- Top management support,
- Law enforcement liaison,
- Union briefing,
- Contractor notification, and
- Chemical testing of body fluids.

Note that establishment of the employee assistance program, or EAP, is only one of the steps in creating what's considered an effective policy.

Established policies communicated to employees vary. At Public Service Electric and Gas Company, for example, the epistle is brief: "A drug-free work environment is especially important in the utility industry because of the basic responsibility of utilities to serve the public safely and without interruption. The responsibility is of even greater significance where nuclear facilities are concerned. . . . Therefore, the unlawful use, distribution, or possession of drugs on company property will not be tolerated."

Others are lengthy, such as the one from Commonwealth Edison Company's. It says that, "While the Company has no intention of intruding into the private lives of its employees, the Company does expect employees to report for work in condition to perform their duties. The Company recognizes that employee off-the-job and on-the-job involvement with drugs can have an impact on the work place and on our ability to accomplish our goal of a drug-free work environment."

In establishing a program, the EEI guidebook cites a number of warning signs to help supervisors. These deal with work performance ("Does the individual have more difficulty concentrating"), social interaction ("Does the individual overreact to real or imagined criticism"), and personal health ("Are you aware of any signs of nerves

POLICY CHECKLIST

In its guide, EEI includes the following checklist to help in shaping a drug and alcohol abuse policy:

1. Do you have a clear, written company policy on drug and alcohol abuse?
2. Has your company given written guidelines on this issue to management and supervisory personnel?
3. Have you provided employees and supervisors with health and safety information on drugs and alcohol and made known the impact that such use on and off the job can have on job performance?
4. Have supervisors been trained to recognize key performance indicators often associated with drug and alcohol abuse?
5. Do your supervisors and management personnel know what to do if they find an employee who may be unfit for duty, under the influence of drugs or alcohol or found in possession of illicit or prohibited substances?
6. If drugs are found on company property or while on company assignment, are local law enforcement and company security promptly notified, and are procedures in place to accomplish this effectively?
7. Is there a medical resource designated for an examination including a urine test for employees suspected not to be fit for duty?
8. Is there an employee assistance program available as a resource to help employees, and are they familiar with how to participate in such a program?
9. Has the company briefed the union, if applicable, on its drug policy?
10. Is the company directing its message at the co-worker as well as the drug and/or alcohol abuser?
11. Have contractors been formally advised that personnel hired by them working on company property or on assignment for the company would be denied access if such individuals violate company drug and alcohol policy and would be referred to local law enforcement if found to be in apparent violation of the law?
12. Is the company policy on chemical testing of body fluids applied consistently and with due care taken to safeguard the integrity of the fluid samples collected?
13. Have provisions been established for performing reliable chemical testing when appropriate?

or emotional upset?").

Policies for supervisor action should also be established. Steps are outlined in the guidebook. For example, if the supervisor observes the **sale**, use or possession of illegal drugs, action should be immediate. Individuals should be questioned separately. Witnesses, including those from the union, should be invited to be present during the questioning.

Employee assistance programs, though, play a key role in effective alcohol abuse programs and policy.

As the guidebook explains, "The availability of rehabilitation assistance to individuals who need it can substantially strengthen such a program."

No one—at any level—is immune. But despite the telltale signs of substance abuse, an employee may deny that he or she has a problem. What should a supervisor do?

Smoking the dried leaves and flowers of the marijuana plant, Cannabis sativa, brings euphoria.

Essentially, the EAP is a referral mechanism, so that valued employees can be given help.

One of the oldest programs is at Potomac Electric Power Company, Washington, D.C. PEPCO's Employee Advisory Service started in May 1976 with the backing of the company's chairman, W. Reid Thompson, according to Robert McKinley, coordinator of the program.

McKinley, who counsels and refers employees to appropriate treatment resources in the community, explained that the service is a "broadbrush" employee assistance program designed to advise employees whose personal problems have an adverse impact on their job performance. These problems could include not only substance abuse, but marital, emotional, financial, and other problems as well. Organizationally, it is a function of the company's medical department, which is part of the human resources group.

At Nevada Power, the program is small, due to the relatively small workforce of 1,367 employees. Says Lewis, "We have several agencies available locally, and our employees are briefed on their services. Employees are free to go to one of

these agencies or to select another one of their choice."

Many EAPs are already into midlife. At Pacific Gas and Electric Company, for example, the focus recently has been on the educational component. Like most, the PGandE program is a "comprehensive, prevention-minded" system, explains Dr. Joe Mattox.

Central to its operation is a three-phase educational program. The first phase concentrates on training supervisors. The objectives include "increasing the awareness of supervisors that work performance may reflect drug abuse," Dr. Mattox explains. The important signs are absenteeism, a high accident rate, and, interestingly, mushrooming grievances. Also part of the first phase is ensuring that supervisors understand their role.

"What is critical here is that some supervisors might be afraid of approaching a person they suspect has a drug problem," Dr. Mattox says.

To overcome that fear, he has organized practice sessions. "We do role playing. That way, supervisors go through the motions and see what it feels like to say, 'I think you have a problem.'"

The four-hour workshops include plenty of details and plenty of practice, he says.

In the second phase, the psychologist focuses on employee education training. This includes an overview of significant drugs—heroin, cocaine, PCP (phencyclidine), as well as alcohol—and how they affect job performance.

Different drugs manifest different symptoms, Dr. Mattox says. "A person on cocaine might actually increase his activity—work longer hours, do more and more. But after a period of time, he may crash." Marijuana smokers and alcohol drinkers generally have higher absentee rates. No one is immune; a company's most valued employees—at any level—may succumb to drugs or drink in the face of personal problems and start to go downhill.

But it is important, Dr. Mattox stresses, that supervisors not become diagnosticians. "If a supervisor has a question about drug abuse, he or she should involve a doctor." At the same time, "it is the responsibility of the employee to prove he or she is fit for duty. Employees must maintain responsibility for their own work performance."

In the third phase, Dr. Mattox has fashioned a program to "train the trainer."

"We have 28,000 employees. With an employee assistance program with nine counselors, we needed to have a training system."

At PGandE, the EAP has been coupled with the firm's safety department.

The most recent addition to the PGandE program is a pre-employment drug screen. Any applicant for employment goes through a physical that includes a urinalysis. The applicant is informed of the purpose for the test, Dr. Mattox says.

In addition to the drug screen,

PG&E's concern is reflected in its company-wide policy on substance abuse and a broadscale EAP which includes not only educational efforts but also assistance in addressing a whole host of problems. Counselors can deal with drug and alcohol problems as well as family, financial, psychological, and job-related stresses.

Because of the relative youth of assistance programs, evidence is sketchy regarding their success. According to a report of the Department of Health, Education, and Welfare (HEW), "the few company programs that are considered to be successful have achieved an effectiveness rate of 50 to 70 percent of employees who receive treatment for substance abuse."[7]

"We have a success rate of about seven out of ten," says McKinley of Potomac Electric Power Company.

Reports PG&E's Dr. Mattox, "Generally speaking, we have seen an increase in the number of people asking for help before it has become a work problem. Some 80 percent are self-referrals."

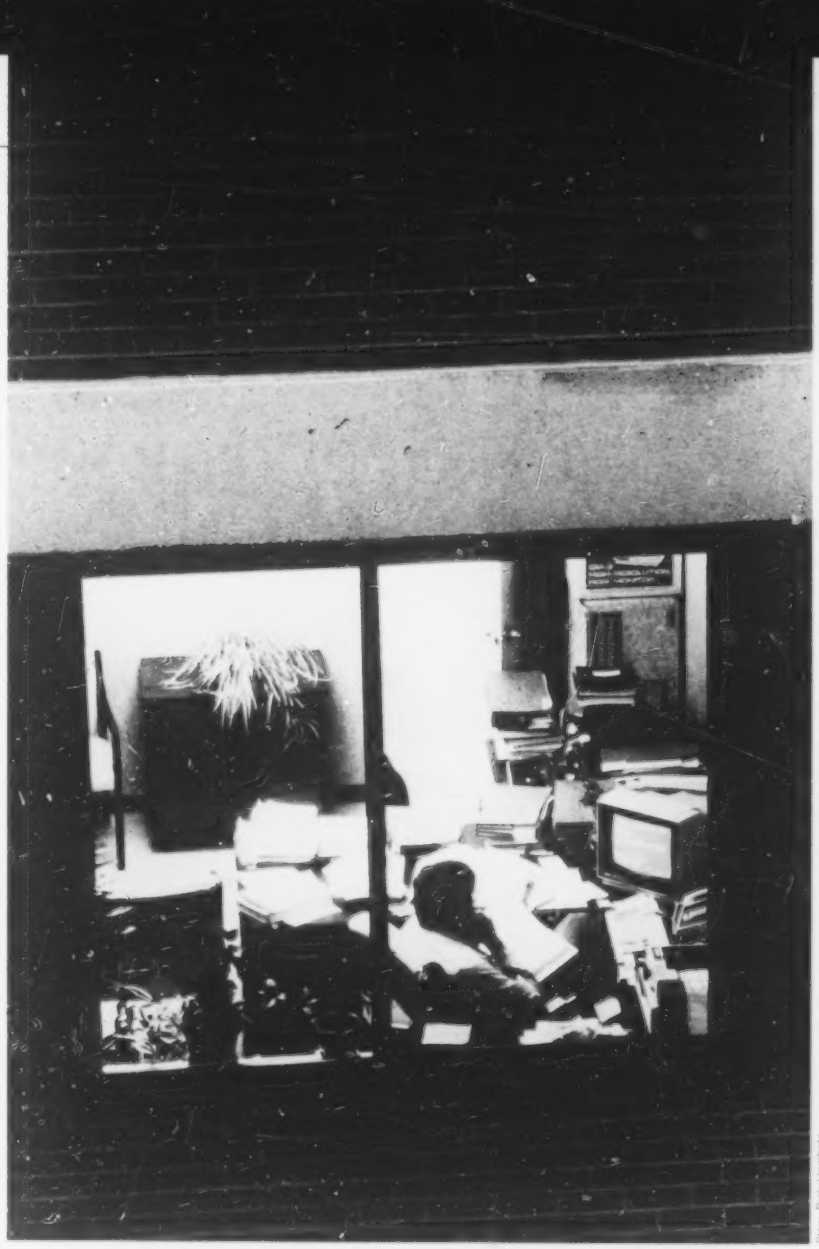
At Nevada Power, Lewis says, "We follow up on people who go through a program to ensure that they stay free of drinking or drugs. We estimate that approximately 65 percent never do alcohol or drugs again."

Some EAP coordinators report less success.

The factors of success? Writes Jerry R. McGuirk in *Alcohol, Health and Research World*, "Among the major components . . . are labor and management cooperation in arriving at an acceptable policy, the training of supervisors in program methodology, the availability of treatment, and adequate referral services and evaluation techniques.

"The type of program used most often by these companies is the 'broadbrush' employee assistance program, in which it is stressed that a wide range of employee troubles, not just alcoholism or other drug abuse, are treated. The emphasis on problems *per se*, it is hoped, will allow employees to enter the program without the stigma so often associated with alcoholism and other drug abuse. An employee whose job performance has slipped below acceptable standards is referred to the program for assessment, diagnosis or assistance, after the supervisor has documented the employee's work performance, taking care not to pass moral judgment or to attempt diagnosis. The employee is confronted with the unsatisfactory job performance record and encouraged to take the recommended corrective action. If the employee repeatedly refuses to accept assistance, with no improved job performance, he or she is cautioned that disciplinary action will commence that will result in job termination. At this junction, most employees will be amenable to assistance."[8]

Understandably, construction of an employee assistance program begs several ethical questions touching on confidentiality, the "right" of treatment, and possible



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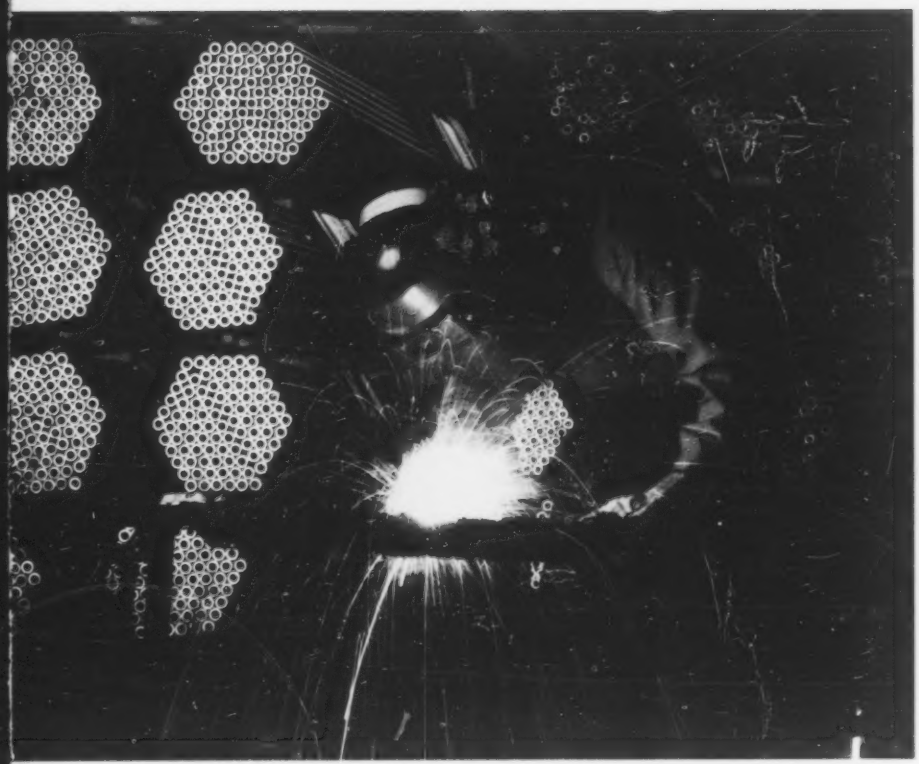
Some workers find that snorting cocaine makes them more productive and able to work longer hours . . . until they crash.



Jon Riley Foto, Inc.

Alcoholics and drug addicts are more accident-prone. They have more medical bills and disability claims; they cause more damage to equipment and facilities; they endanger their co-workers.

conflicts of interest in therapeutic goals.

As for conflicts, researcher Jacob I. Melamed points to situations where the responsibility for the program is awarded to an outside contractor. "Covert organizational expectations may create a potential for conflict," he wrote in an HEW publication.[9] "Desire to insure renewal of the contract may influence the contractor to appear especially 'effective' in resolving situations involving management-referred troubled employees. The pressure to provide 'results,' to accede to implied, unstated demands by the organization that the contractor 'take care of' its troubled employees, can result in conflicts of interest similar to those of in-house occupational programs."

And what about the "right" to treatment? Since denial is a widely recognized symptom of alcoholism and drug abuse, how does this enter into an employee's right not to receive treatment? It is common in occupational programs to confront the drug abuser with possible job action as a means of countermanding that denial. At what point does coercion become interference with personal rights?

Employee confidentiality is vulnerable. The most common violation is through the release of information by the occupational program counselor. An increased awareness and constant vigilance on the part of the counselor as to what information must actually be disclosed can minimize this source of intrusion on the employee's expectation of confidentiality.

These problems aside, researchers are generally optimistic about controlling substance abuse. Former space program advisor Dr. Berry conveys to corporate managers a message they may pass on to their employees: "In today's frustrating and stress-producing world, where it seems we can't control very much, we can do much to control our own health. These efforts are greatly aided by well-conceived and carefully executed programs in the worksite, and thus help companies reduce overall health care costs."[10]

As the EEI guide notes, employees are a company's most valuable resource. Maintaining a substance-free workplace is in everyone's best interest.

Notes

1. "Taking Drugs on the Job," *Newsweek*, August 22, 1983, p. 52.

2. Steven Flax. "The Executive Addict," *Fortune*, June 24, 1985, p. 24.

3. *Newsweek*, p. 54.

4. Joan O'Connell and Bob Arnold. "Companies Are Starting to Sniff Out Cocaine Users," *Business Week*, February 18, 1985, p. 37.

5. Dr. Charles A. Berry. "An Approach to Good Health for Employees and Reduced Health Care Costs for Industry," National Institutes of Health, pamphlet, no date.

6. J. Michael Swint and David R. Larson. "Employee Assistance Programs: Incentives for Increasing State and Local Support," *Alcohol, Health, and Research World*, U.S. Department of Health and Human Services, Winter 1983/84, p. 35.

7. Terry R. McGuirk. "Evaluation and Development of Employee Assistance Programs," *Alcohol, Health, and Research World*, U.S. Department of Health, Education, and Welfare, Spring 1980, p. 17.

8. *Ibid.*

9. Jacob I. Melamed. "Ethical Issues in Occupational Programs," *Alcohol, Health, and Research World*, U.S. Department of Health, Education, and Welfare, Spring 1980, p. 39.

10. Dr. Charles A. Berry. "An Approach to Good Health for Employees and Reduced Health Care Costs for Industry."

The New Law on Leaking Underground Storage Tanks

Electric utilities own more than 15,000 tanks that will cost plenty to test, repair or replace, but the alternative could cost even more.

In 1984, while public attention focused on Congressional efforts to reauthorize and expand the nation's hazardous waste and Superfund regulatory programs, a little-noticed new regulatory program concerned with leaking underground storage tanks became law. What was unusual about this legislation is that few environmental organizations pushed for its enactment; indeed, despite the potentially high cost of compliance, it generated little or no opposition from the industries likely to be most affected.

The momentum for enacting the legislation came almost entirely from local incidents of groundwater contamination stemming from leaking underground tanks in the districts of key members of Congress who serve on the committees responsible for environmental legislation. The principal sponsors were not members usually associated with legislative activism on environmental issues; the chief sponsors were Senator David Durenberger (R-Minn.) and Representative Donald L. Ritter (R-Pa.), mainstream Republicans on regulatory matters.

Until this time, the prevailing attitude toward underground tanks had been "out of sight, out of mind." However, repeated incidents of leaks from underground tanks—a great many of them involving gasoline at retail service stations—provided strong evidence of a significant threat to the nation's groundwater resources. With little evidence of the magnitude or cost of preventive or corrective action, but alarmed by this growing risk to underground drinking water sources, Congress adopted a far-reaching program to regulate not merely gasoline service station tanks, but the more than three million underground tanks thought to exist nationwide.

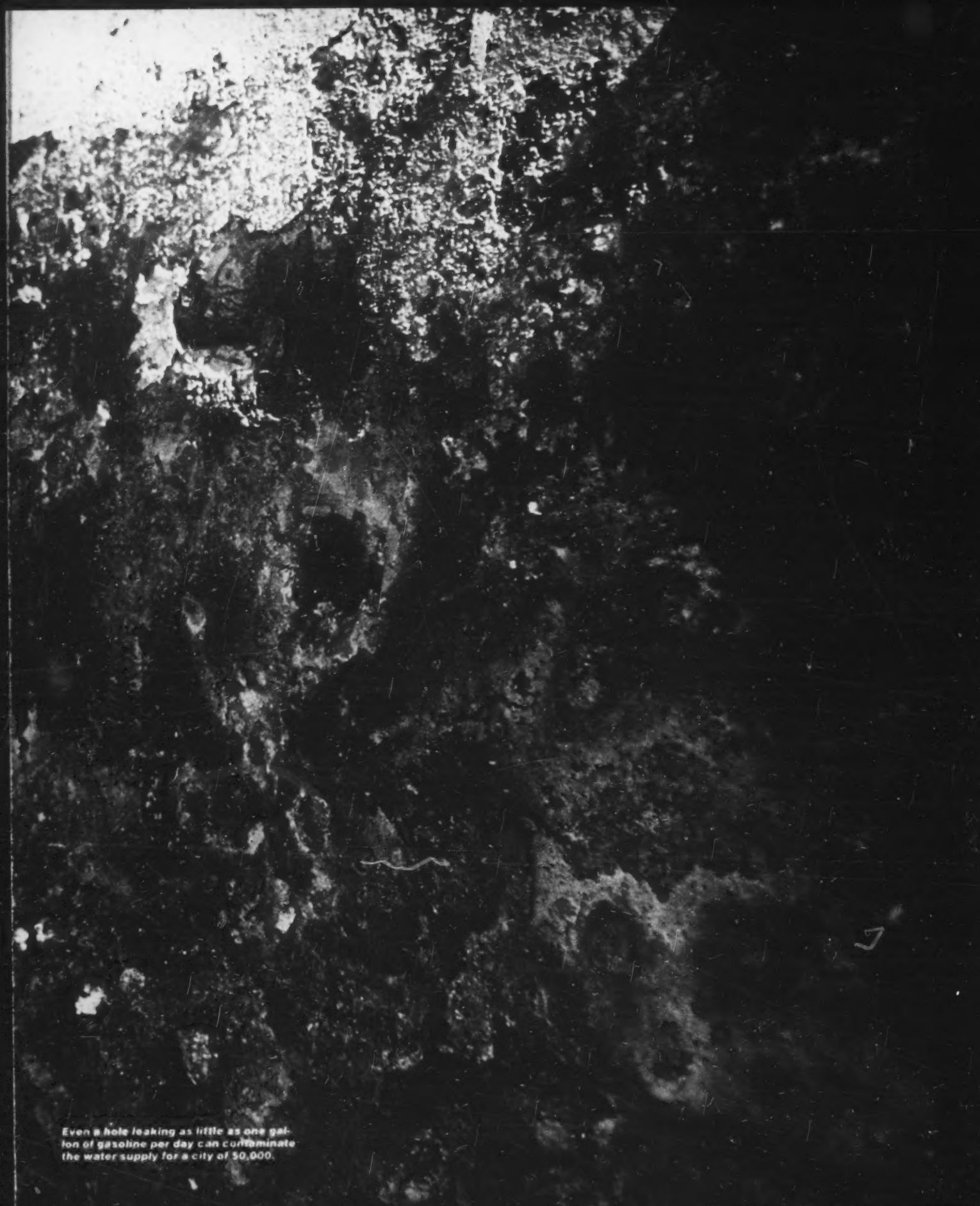
The program was added as a rider to the 1984 reauthorization of the Resource Conservation and Recovery Act (RCRA), the statute under which most hazardous and solid wastes are regulated at the federal level. With no fanfare or public ceremony, President Reagan signed the bill into law on November 8, 1984. Despite the inevitable jokes, the Leaking Underground Storage Tank program has been dubbed by the Environmental Protection Agency (EPA) as the LUST program.* Electric utilities, which own more than 15,000 tanks, will soon discover, if they have not already, that even though underground tanks continue to be "out of sight," these tanks will be very much on the minds of utility management as they face significant capital expenditures and possibly costly cleanup requirements under the new LUST program.

*The LUST acronym has been widely accepted in the governmental and industrial communities, and, accordingly, it is used in this article. However, shortly before this magazine went to press, EPA renamed the program the "Underground Storage Tank" or UST program. It remains to be seen whether the new name will catch on beyond EPA.

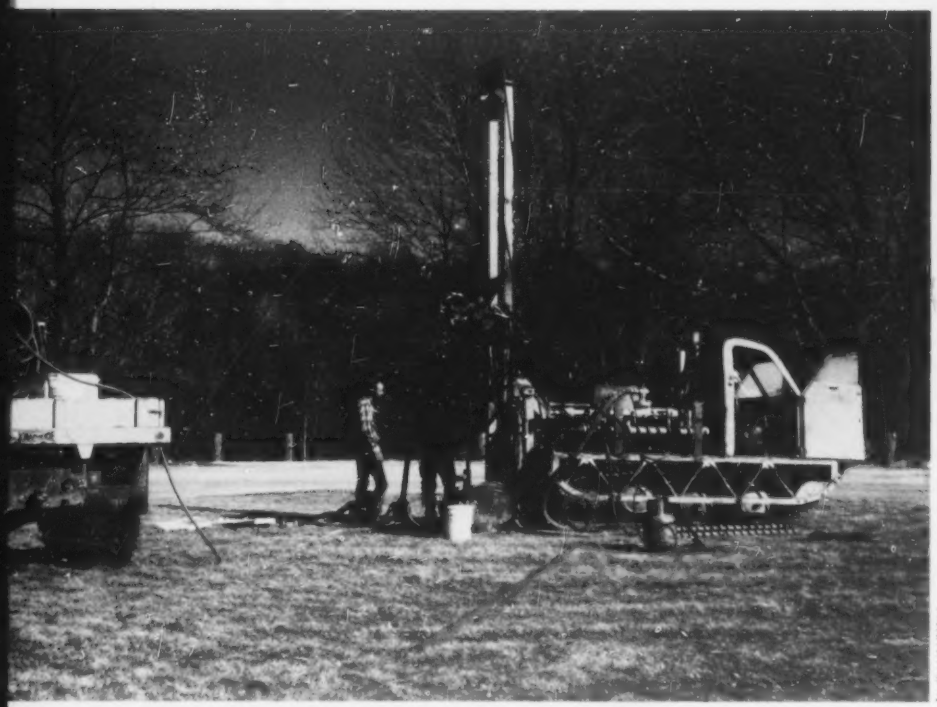
WILLIAM A. KUCHARSKI is Manager of Environmental Engineering for Pacific Power & Light Company and Chairman of the Utility Solid Waste Activities Group's Leaking Underground Storage Tank Committee. WILLIAM R. WEISSMAN, a partner with the Washington, D.C., firm of Wald, Harkrader & Ross, is counsel to that committee.

Electric Utility Tanks

The petroleum and chemical manufacturing industries are the major owners and operators of regulated underground tanks. Electric utilities and utility industry affiliates, such as natural gas and telecommunications operations, also are major users of underground storage tanks. While most utility industry tanks are below 25,000 gallons in size, some utilities—particularly those with oil-fired power plants—have extremely large tanks that exceed 100,000 gallons capacity. The industry uses its tanks primarily to store petroleum products, though a small percentage stores a variety of other substances, some of which are regulated as hazardous under RCRA or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund). The majority of utility underground tanks are found at distribution and service centers, set up much like retail gasoline service stations. Relatively few underground tanks are located at generation facilities.



Even a hole leaking as little as one gallon of gasoline per day can contaminate the water supply for a city of 50,000.



Northeast Utilities

Northeast Utilities

Northeast Utilities, headquartered in Hartford, Connecticut, launched a management program for its 400 underground tanks in 1984. A groundwater monitoring well is drilled at one service center where a gasoline tank was found to be leaking.

Above, right:
An environmental technician with Northeast Utilities (NU) measures groundwater levels.

The Utility Data Institute conducted a nationwide survey of the industry's underground tanks in 1984 for Edison Electric Institute's Groundwater Task Force. The survey confirmed that utilities own a large number of tanks—the average number per utility was 63, but 200 or more tanks per utility was not uncommon. The survey also revealed that a vast percentage of the tank population is more than five years old; indeed, nearly 40 percent of the tanks are over 15 years old. While most tanks (85 percent) are made of steel, the owners of more than half of the tank population reported no corrosion protection, and nearly three-quarters reported no leak detection or testing devices.

The High Cost of Groundwater Contamination

At the time Congress enacted the LUST program, it assumed that the nationwide population of underground tanks was two million (current estimates are far higher). Based on the two-million-tank estimate, Congress accepted estimates that as many as 75,000 to 100,000 underground tanks (under 5 percent) may now be leaking and that 350,000 tanks may leak within five years.* More recent sources estimate that from 10 to 30 percent of underground tanks may be leaking today. Whatever the correct figures, there is little doubt that a large number of tanks are leaking, many more soon will leak, and the danger to the nation's groundwater resources and subsurface environment from such leaks is significant. A leak of one gallon per day, according to EPA, can contaminate the water supply for a city of 50,000. Data do not indicate any correlation between size of tank, size of leak, and environmental impact. It is evident, however, that a small leak from a small tank can cause significant environmental damage. EPA has already listed more than a dozen leaking tank sites on the National Priority List for cleanup under the Superfund program.

The potential liability facing a company with a leaking underground tank can be very high, especially if groundwater has been contaminated. For instance, one Silicon Valley electronics manufacturer had a waste solvent tank which was four years old when it began leaking. It leaked a total of 56,000 gallons during an 18-month period. The solvents traveled through the soil and affected three aquifers. So far, the company has sunk more than 70 wells, has removed the tank and the surrounding soil, and reportedly has spent $12 million. At a Long Island service station site, the claims that followed the discovery of a leaking gasoline tank have totalled more than $2 billion. While the ultimate

*H.R. Conf. Rep. No. 98-1133, 98th Cong., 2d Sess. at 128 (1984).

extent of liability may prove to be significantly below this extraordinary figure, the cost of cleaning up environmental damage to groundwater and subsurface environment nevertheless is usually quite high.

While there is no definitive evidence of leaks in a high proportion of tanks owned by utilities, there is cause for concern because a large percentage of these tanks were installed years ago without state-of-the-art protection against corrosion and leakage. One eastern utility recently investigated its gasoline tanks and found them to be leaking considerably less than the national leak estimate, despite the fact that its own tanks generally were slightly older than the national average. But even if this more favorable experience is typical of the industry as a whole, the industry still could face massive cleanup expenditures because site cleanups can easily cost millions of dollars, depending on the extent of contamination and other site-specific factors. If utility tanks turn out to be typical of tanks nationwide, and if estimates that 10 to 30 percent of underground tanks may be or soon will be leaking, total utility industry liabilities theoretically could reach the billions of dollars level.

The Legislative Requirements

The new LUST legislation has three major aims: (1) to conduct a census of all existing underground tanks, (2) to formulate design standards for new tanks, and (3) to establish basic operating standards for all tanks which will prevent and detect leaks and require corrective action where needed. Like other recent federal environmental statutes, LUST requires minimum federal standards to be promulgated by EPA, but the states may acquire primary enforcement responsibility if they adopt a regulatory program no less stringent than the EPA program. EPA, however, retains broad authority to bring civil and administrative enforcement actions, including the authority to impose daily $10,000 per tank civil penalties for regulatory violations. Unlike its action on the other statutes, however, Congress declined to require that a permit program for tanks be established.

One part of the legislation has already gone into effect. As of May 8, 1985, installation of bare steel tanks for storing regulated substances is prohibited (except in dry areas with high resistivity soil) unless the tank meets stringent cathodic protection standards, is designed to prevent leaks during its operational life, and has a wall or lining that is compatible with the

To test its tanks, NU contracted with Hunter Environmental Services of Malvern, Pennsylvania. Hunter deployed two-person teams with specially equipped vans to perform tests and analyze the results. No excavation was necessary.

Hunter Environmental Services

substance to be stored. This prohibition will automatically expire whenever EPA implements new tank performance standards.

A one-time nationwide census of existing underground tanks covered by the statute is to occur by May 8, 1986, when owners of such tanks must file a notification form with the state in which each tank is located. The form requires information about the age, size, type, and location of each tank still in service. Any underground tank taken out of service since January 1, 1974, unless it has been removed from the ground, also must be reported. The notification is to be filed solely with the state, not with EPA. If the tank was taken out of service and sold prior to November 8, 1984, the seller (not the current tank owner) must file the notification. Tanks installed after May 8, 1986, must be reported to the state within 30 days of installation. The states are free to expand on the inquiries on the federal form if they choose.

A threshold question facing tank owners is whether their tanks are covered by the statute and hence must be reported to the states. Many above-ground tanks, in fact, will be regulated as underground tanks under the LUST program because the legislation broadly defines an underground storage tank to include installations where 10 percent or more of the volume of the tank and its connecting pipes is underground. Thus, if the volume of underground piping is high enough, an above-ground tank becomes subject to the program. In addition, the tank also must be used to store a "regulated substance"—that is, petroleum products or hazardous substances covered by the Superfund statute. Tanks containing hazardous wastes covered by the RCRA permit requirement are excluded from the LUST program.

The Ravender Company

A team manager reviews a strip chart that shows weight fluctuations detected by Hunter's "Leak Lokator" system. Line patterns on the chart can reveal leaks smaller than 5 100ths of a gallon per hour.

Even if a tank meets the "underground" volume standard and contains a "regulated substance," it still may be exempt. The statute expressly excludes certain small farm and residential tanks, heating oil tanks, septic tanks, regulated pipelines, waste water and storm water collection systems, surface impoundments, flow-through process tanks, and tanks placed above floor level in underground areas. However, many questions still remain unanswered. How will the definition of "tank" be applied to structures such as sumps? What constitutes a flow-through process system? EPA will have to answer these and many other questions before the regulatory impact of the program on the utility industry can be fully gauged.

Another important feature of the legislation requires EPA to issue regulatory standards for new

A hydrogeologist at NU samples effluent from the carbon filtration system at a discharge outlet to a storm sewer.

and existing tanks according to a staggered schedule during 1987 and 1988. EPA's present plan, however, is to issue these regulations in a single package by February 1987.

The legislation states the applicable regulatory standard in a general way—the regulations must "protect human health and the environment"—and delegates broad discretion to EPA to formulate the precise requirements within that general standard. In addition, the regulations for new tanks must include standards for design, construction, installation, release detection, and compatibility. The regulations for existing tanks must include requirements for leak detection systems (the statute suggests a combination of an inventory control system and tank testing), recordkeeping and reporting requirements, corrective action requirements, and tank closure standards. EPA also may require tank owners to provide evidence of financial responsibility for taking corrective action or compensating third party victims of any tank releases. Because of the lag in implementing corrective action regulations for petroleum releases from underground tanks (the Superfund already covers releases of hazardous substances but does not cover petroleum releases), Congress is considering an amendment to the LUST statute to require EPA to undertake immediate corrective action, if necessary, using funds to be earmarked for this purpose from the existing Superfund.

Congress has committed EPA to an extremely ambitious regulatory agenda in a short period of time. The timetable imposed by statute leaves EPA very little time to answer some extremely difficult regulatory questions:

- Should the regulatory standards for all tanks be uniform, or should they take account of site-specific variables such as climate, soil, and hydrogeology?
- To what extent should economics or financial burden affect the standards to be promulgated? One utility reported budgeting approximately $10 million to comply with far-reaching state-imposed tank requirements.
- Should existing steel tanks be required to retrofit with cathodic protection to minimize the risk of corrosion?
- Should secondary containment be mandatory for all tanks? This could include a double-walled tank, an external liner or a vault.
- What leak detection methodology should be prescribed? Inventory controls? In-the-tank monitoring devices? Should soil or groundwater monitoring be required? The latter could impose an annual cost of over $2,500 per tank.
- Should old tanks be subject to mandatory retirement even in the absence of detected leakage? Should they be subject to more frequent tank testing?
- Before returning a leaking tank to service, should it be upgraded to meet new tank standards in addition to being repaired?
- Should removal from the ground and soil decontamination be required for all tanks permanently removed from service? If not, should groundwater monitoring be required for a prescribed post-closure period?

EPA tentatively answered some of these questions as they would apply to tanks subject to the RCRA hazardous waste permit program. In proposed hazardous waste tank regulations published recently, EPA suggested, among other things, (1) a requirement for secondary containment for all new tanks, (2) an option for existing

underground tanks either of installing secondary containment or, alternatively, of conducting groundwater monitoring and semi-annual tank testing (aboveground portions of tanks would be required to have partial secondary containment in either case); (3) mandatory corrosion protection for new tanks; (4) removal of the tank and ancillary equipment at closure and decontamination of any contaminated soil or compliance with post-closure groundwater monitoring standards applicable to hazardous waste landfills; and (5) engineer certification of proper tank installation. Although EPA cautions that these proposed hazardous waste regulations should not be considered a harbinger of its future LUST program regulations, they nevertheless provide a model which EPA may find irresistible as the statutory deadline for publishing the LUST regulations approaches.

State Programs

A number of states already have enacted their own programs to regulate underground storage tanks. New York, Connecticut, Florida, and California, for example, have extensive regulatory programs that go far beyond EPA's current approach. The California program, in particular, has imposed substantial burdens on tank owners by setting action-forcing deadlines and has divided responsibility between many different state and local authorities. One California company, for example, has had to deal with over 50 separate government agencies.

Most of the state programs are not as complicated or burdensome as those mentioned above. Many state regulatory programs are aimed principally at fire or explosion hazards of underground tanks and are modeled on National Fire Protection Association Code 30 standards. These state programs will have to be expanded to meet EPA LUST standards if enforcement of the federal program is to be delegated to those states.

History has shown that many underground systems leak and that such leaks can have a catastrophic impact on drinking water resources.

Industry Response

As soon as the new legislation was enacted, the petroleum, chemical, and utility industries took an active interest in the implementation of the new program. The American Petroleum Institute (API) has been particularly visible in alerting government, industry, and citizens' groups to the implications of the new law and proper installation and management techniques for underground storage tanks. API generally has shared its research with other industries to reduce the risk of leakage.

Because the LUST regulations will significantly impact electric utilities, the industry mobilized quickly to monitor EPA activities in this area and to present the industry's view on how to implement the environmental aims of the statute in a cost-efficient manner. Primary responsibility for the LUST program within the industry was assigned to the Utility Solid Waste Activities Group (USWAG), the ad hoc utility group that has been responsible for the industry's RCRA regulatory activities. The EPA staff responsible for formulating LUST regulations is the same staff that recently worked with USWAG and the industry in connection with EPA's study of utilities' fossil fuel combustion byproducts. That staff has welcomed the industry's suggestions on formulating sound regulations to implement the program. In short, the working relationship between EPA and the electric utility industry on LUST issues is "off to a running start."

A "LUST Committee" was promptly organized within USWAG, and approximately 25 utili-

Hunter tester drops a probe into a tank's fill pipe to monitor temperature changes that can affect liquid volume. The probe is connected to the strip chart recorder inside the van.

Northeast Utilities

An NU chemist examines effluent samples for hydrocarbon content.

ties from around the country thus far have assigned representatives to that committee. Representatives from additional utilities are welcome to join the committee. Two working task forces were established among committee members—one concerned with performance standards and the other with remedial action standards—and several important research projects have been undertaken. The Performance Standards Task Force is compiling evaluations of state-of-the-art tank and piping technology and installation practices and commercially available tank and pipe testing methodology. These data not only will assist the committee in preparing the industry's position on EPA's proposed regulations, but they also will be made available to USWAG member companies for their own tank installation and management programs.

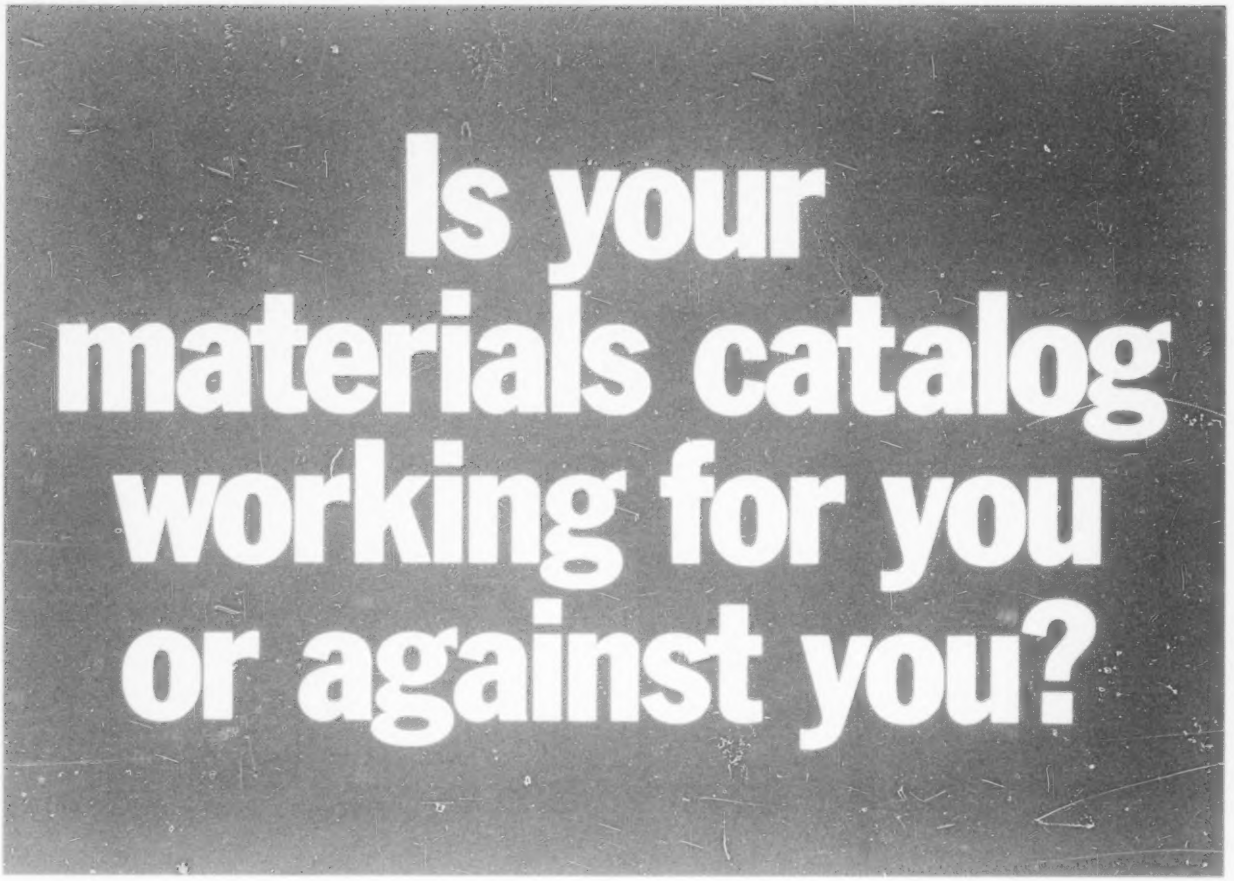
The committee, in cooperation with the Electric Power Research Institute (EPRI), is developing a decision matrix with which individual utilities can assess the environmental risks posed by existing underground tanks and the available options for minimizing those risks.

Finally, the Remedial Action Task Force is actively developing a general response plan or decision framework to assist utilities in responding to a suspected leak. This plan will cover the sequence of events beginning with a suspected leak and ending with ultimate resolution of any tank failure either by removing the tank from service or by its repair and reinstatement of service. This response plan will be distributed within the industry and may be submitted to EPA to aid the agency in drafting practical and flexible corrective action regulations.

No More "Out of Sight, Out of Mind"

It is already evident that the fledgling LUST program could grow massively to a size that matches the RCRA hazardous and solid waste programs. No one yet knows precisely how many tanks will be affected by this program, but it is already clear that most projections have underestimated the number of tanks and the number of leaking incidents requiring some form of corrective action.

When Congress abandoned the old "out of sight, out of mind" attitude towards underground tanks and passed the LUST statute in 1984, it directed EPA to take a broad range of actions to prevent tank leaks and to clean up leaks that have occurred. History has shown that many underground systems leak and that such leaks can have a catastrophic impact on drinking water resources. Compliance with the new law will be costly; but the cost of remedying environmental damage usually is even higher. Given the utility industry's large and aging population of underground tanks, it is unlikely that utilities will escape the major burdens imposed by this program. By 1987 and 1988, the size of these burdens should become clearer.



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21	Chrysler	45	Ashland Oil	69	Bethlehem Steel	93	Bristol-Myers	117	American Can
22	Procter & Gamble	46	General Dynamics	70	Weyerhaeuser	94	Martin Marietta	118	Reynolds Metals
23	R.J. Reynolds Ind.	47	3M	71	Ralston Purina	95	Firestone Tire & Rubber	119	Campbell Soup
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FINANCIAL REVIEW

1985 FIRST QUARTER EARNINGS PER SHARE UNCHANGED FROM PRIOR YEAR

The investor-owned electric utility industry earned 89 cents per share on electric operating revenues of $30.7 billion in the first quarter of 1985 (see Table 1). Earnings per share for the industry were flat for the second quarter in a row, on a 1.1 percent increase in electricity sales. Net income available for common was up to $4.9 billion, an increase of 7.2 percent. Average shares outstanding increased 8.3 percent, a slightly higher increase than the average gain of the past four quarters. This put downward pressure on earnings per share (net income available for common stock divided by the number of shares outstanding), which ended the first quarter unchanged from the first quarter of 1984.

A rise in total electric sales and the effects of rate increases contributed to the first quarter's 7.1 percent gain over electric operating revenues of the first quarter of 1984. For the twelve months ending March 31, 1985, operating revenues were $121.5 billion, an 8.9 percent increase.

Total electric operating expenses kept pace with revenues, rising 7.0 percent and 8.8 percent respectively, for the quarter and the year ended March 31, 1985. Expenses edged down slightly as a percentage of total electric operating revenues, from 80.9 percent for the first quarter of 1984 to 80.8 percent in 1985. Although some companies encountered higher fuel and purchased power expense and a decline in recoverable fuel cost, the industry's fuel cost during the first quarter increased only 3.5 percent compared to a 5.5 percent increase from 1983 to 1984. Scheduled outages for some utilities and severe winter storms in the Great Lakes region contributed to the 9.9 percent increase in operation and maintenance costs. Depreciation and amortization rose 12.1 percent as more plants were put into service.

Income taxes paid in the first quarter of the year were 25 percent higher than those paid in the same period of 1984, reflecting the industry's gain in pre-tax income. Accumulated deferred income taxes increased by over 48 percent. Several companies recognized abandonment losses on nuclear facilities and provided for the difference between tax and financial accounting, which contributed to the increase.

Other utility income was up only 6.7 percent to $782 million. Lower gas revenues resulted from lower average gas rates and a decrease in sales caused by milder winter weather in most parts of the country. Non-utility income continued to be strong, with a 21.2 percent increase over the period ended March 31, 1984.

The allowance for funds used during construction (AFUDC), which represents the cost of equity and borrowed funds used to finance construction, increased only 4 percent over total AFUDC in the first quarter of 1984 and only 2.7 percent for the twelve-month period. This was less than half of the 8.2 percent increase from March 31, 1983, to March 31, 1984. AFUDC dropped to 43.9 percent of net income available for common, compared to 45.3 percent in 1984. Construction work in progress (CWIP) increased less than a percent over the first quarter of 1984. That caused a decline in the ratio of CWIP to plant in service, from 51.6 percent for the previous year to 45.9 percent.

Looking at the balance sheet for a snapshot of the industry's financial condition on March 31, 1985, we see that assets increased 10.4 percent over the first quarter of 1984, to $389 billion (see Table 2). Total capitalization reached $300.5 billion, a 7.9 percent gain. The 16.3 percent increase in retained earnings was reflected in the industry's 41.3 percent equity ratio. Common stock equity as a percent of total capitalization was only 40.5 percent a year ago. Preferred stock as a percent of total capitalization fell to 10.6 percent from 11.5 percent. Long-term debt rose to 48.1 percent from 48.0 percent at March 31, 1984. The return on average common equity was 14.6 percent.

Interest expense on long-term debt rose 10.2 percent to $3.6 billion, while other interest expense fell 5.8 percent. Pre-tax interest coverage for the quarter (including AFUDC) dipped slightly to 3.23 times compared to 3.27 times in 1984. The coverage ratio of 3.08 times for the twelve months ending March 31, 1985, is only marginally lower than the 3.09 times at the end of 1984.

Common stock dividends were flat for the quarter and showed only a 1.3 percent increase for the twelve months ending March 31, 1985. The dividend payout ratio of 60.1 percent compares to 59.5 percent for the first quarter of 1984. Several companies with financial difficulties omitted or reduced dividends for the first quarter as they did in the last quarter of 1984. Excluding these companies from our sample, dividends per share increased 4.4 percent and 5.8 percent for the quarter and the twelve-month period, respectively. This growth rate is more indicative of the portion of the industry paying dividends. EP

Contributed by the Finance and Regulation Department of Edison Electric Institute.

Table 1
INVESTOR-OWNED ELECTRIC UTILITY INDUSTRY STATEMENT OF INCOME
(Unaudited)
(Millions of dollars)

	Three Months Ending March 31,			Twelve Months Ending March 31,		
	1985	1984	% Change	1985	1984	% Change
Total Electric Operating Revenues	$30,660	$28,618	7.1	$121,521	$111,572	8.9
Electric Operating Expenses						
Fuel	$ 9,254	$ 8,940	3.5	$ 37,812	$ 36,152	4.6
Other Operation & Maintenance	7,795	7,092	9.9	30,683	27,256	12.6
Depreciation & Amortization	2,472	2,206	12.1	9,495	8,417	12.8
Taxes Other Than Income Taxes	2,263	2,137	5.9	8,663	8,032	7.9
Income Taxes (Federal & Other)	1,274	1,019	25.0	4,741	3,614	31.2
Provision for Deferred Income Taxes	956	1,016	(5.9)	4,866	4,898	(0.7)
Investment Tax Credit Adjustment, Net	772	751	2.8	2,001	1,923	4.1
Total Electric Operating Expenses	$24,786	$23,161	7.0	$ 98,261	$ 90,292	8.8
Electric Operating Income	$ 5,874	$ 5,457	7.6	$ 23,260	$ 21,280	9.3
Other Utility Operating Income	782	733	6.7	1,531	1,394	9.8
Total Utility Operating Income	$ 6,656	$ 6,190	7.5	$ 24,791	$ 22,674	9.3
Other Income	715	590	21.2	2,204	1,875	17.5
Allowance for Other Funds Used During Construction	1,341	1,274	5.3	5,292	5,138	3.0
Total Income Before Interest Charges	$ 8,712	$ 8,054	8.2	$ 32,287	$ 29,687	8.8
Interest Charges						
Interest on Long Term Debt	$ 3,621	$ 3,286	10.2	$ 14,124	$ 12,744	10.8
Other Interest Expenses & Charges	259	275	(5.8)	1,164	1,146	1.6
Allowance for Borrowed Funds Used During Construction	(820)	(804)	2.0	(3,263)	(3,189)	2.3
Net Interest Expenses & Charges	$ 3,060	$ 2,757	11.0	$ 12,025	$ 10,701	12.4
Net Income Before Extraordinary Items	$ 5,652	$ 5,297	6.7	$ 20,262	$ 18,986	6.7
Extraordinary Items	0	18	(100.0)	(34)	(258)	(86.8)
Net Income	$ 5,652	$ 5,315	6.3	$ 20,228	$ 18,728	8.0
Preferred Dividends Declared	732	726	0.8	2,926	2,836	3.2
Net Income Available for Common	$ 4,920	$ 4,589	7.2	$ 17,302	$ 15,892	8.9
Common Dividends Declared	2,955	2,731	8.2	11,313	10,523	7.5
Additions to Retained Earnings	$ 1,965	$ 1,858	5.8	$ 5,989	$ 5,369	11.5
Avg. Shares Outstanding	5,558	5,134	8.3	5,331	5,025	6.1
Earnings Per Share*	$ 0.89	$ 0.89	0.0	$ 3.25	$ 3.16	2.6
Common Dividends Per Share*	$ 0.53	$ 0.53	0.0	$ 2.12	$ 2.09	1.3

*Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
NOTE: Revenues are adjusted for intra-industry sales for resale of electricity.

Based on unaudited reports submitted by a sample of electric utilities representing approximately 94 percent of the industry's revenues from sales to ultimate customers and 93 percent of the industry's total assets. Data expanded to represent the entire investor-owned electric utility industry.

Table 2
INVESTOR-OWNED ELECTRIC UTILITY INDUSTRY BALANCE SHEET
As of March 31, 1985
(Unaudited)
(Millions of dollars)

Assets	1985	1984	% Change
Utility Plant*			
Utility Plant (Including Nuclear Fuel)	$310,450	$276,401	12.3
Less Accumulated Depreciation	88,129	79,784	10.5
Total	$222,321	$196,617	13.1
Construction Work in Progress	101,950	101,450	0.5
Net Utility Plant	$324,271	$298,067	8.8
Investments	8,077	6,748	19.7
Current Assets	37,905	34,350	10.3
Deferred Debits	18,979	13,420	41.4
Total Assets	$389,232	$352,585	10.4
Capitalization & Liabilities			
Capitalization			
Common Stock	$ 81,038	$ 75,732	7.0
Retained Earnings	43,190	37,128	16.3
Preferred Stock	31,775	31,960	-0.6
Long-Term Debt	144,574	133,644	8.2
Total Capitalization	$300,577	$278,464	7.9
Current Liabilities			
Short-Term Debt	$ 4,562	$ 4,779	(4.5)
Long-Term Debt Due Currently	4,081	4,075	0.1
Other Current Liabilities	28,889	26,678	8.3
Total Current Liabilities	$ 37,532	$ 35,532	5.6
Deferred Credits			
Accumulated Deferred Income Taxes	$ 28,779	$ 19,378	48.5
Accumulated Deferred Investment Tax Credits	14,511	12,855	12.9
Other Deferred Credits	7,833	6,356	23.2
Total Deferred Credits	$ 51,123	$ 38,589	32.5
Total Capitalization & Liabilities	$389,232	$352,585	10.4

*Includes other utility plant of combination gas and electric companies.

Based on unaudited reports submitted by a sample of electric utilities representing approximately 94 percent of the industry's revenues from sales to ultimate customers and 93 percent of the industry's total assets. Data expanded to represent the entire investor-owned electric utility industry.

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TECHNOLOGY REVIEW

GENERAL MOTORS ELECTRIC VAN PROJECT

The Electric Vehicle Development Corporation (EVDC) of Cupertino, California, has established a plan for and is managing a joint project to introduce electric vans into the commercial fleet vehicle market.

Called the General Motors Electric Van Market Application Development Project, the effort involves General Motors Corporation (GM), Bedford Commercial Vehicles, Lucas Chloride EV Systems (LCEVS), the Tennessee Valley Authority (TVA), Detroit Edison Company, and the Electric Power Research Institute (EPRI) working together with EVDC in support of the operation of GM electric vans within utility and non-utility service fleets. This project is designed to provide the necessary ingredients for achieving EVDC's near-term electric vehicle (EV) commercialization objective—the introduction of a market-acceptable electric van for use within commercial service fleets during the late 1980s.

The GM Electric Van Market Application Development Project consists of four interrelated phases that allow for the gradual evolution of the technology, its market, and its support systems. The GM electric van was selected for this project because of its performance capabilities and proven reliability, as well as the manufacturers' commitment to develop the necessary vehicle support systems.

The vehicle infrastructure systems and initial market developed in support of the introduction of the GM van will serve as the foundation for future market expansion. As other electric vehicles that can meet market requirements become available, they will benefit from the experience gained from this first project.

The emphasis on electric vans and commercial fleets as the most desirable initial technology and market targets follows from the results of a national market study, *Electric Vehicles in Commercial Sector Applications*, July 1984, funded by EPRI and conducted by Detroit Edison Company and the University of Michigan. By nature, fleet operations—with their restrictive daily vehicle usage and centralized storage and servicing, and with the importance of life cycle costs in vehicle purchase decision making—are more compatible with near-term EV technology capabilities than are personal use applications. The market potential for electric vans is significant. An estimated 2.4 million vans are currently in use in commercial fleets.

Achieving the overall objective of the GM Electric Van Market Application Development Project will require:

- Demonstrating the suitability and reliability of electric vans in fleet applications.
- Substantiating the potential cost competitiveness of EVs.
- Establishing model EV service and support systems.
- Identifying effective marketing methods and user incentives.
- Transferring Bedford and LCEVS technology to the United States.
- Dispelling existing negative perceptions regarding EVs and their long-term potential.

To minimize the risks associated with such an ambitious undertaking, the project has been divided into four phases:

Phase 1: Van Acceptance Testing
Phase 2: Field Evaluation and Infrastructure Development
Phase 3: Van Deployment
Phase 4: Technology Transfer for U.S. Market

The project was initiated in September 1984 and current plans call for its continued operation through December 1988. Phase 1, Van Acceptance Testing, has been successfully completed, and the fleets participating in the Phase 2 Field Evaluation and Infrastructure Development will begin the operation of some 30 electric vans in July and August 1985. Seven electric utilities are participating in Phase 2:

Detroit Edison Company
Florida Power Corporation
Hydro Quebec
Public Service Company of New Mexico
San Diego Gas and Electric
Southern Company Services
Tennessee Valley Authority

Phase 3, which is scheduled to begin in July 1986, will involve the expansion of the vehicle service and support systems established in Phase 3. The final stage of the project, Phase 4, is scheduled to begin in July 1987.

A key aspect of this project is the establishment of the necessary EV infrastructure system to support the operation and maintenance of the vans. GM, Bedford, and LCEVS are working together to develop vehicle service and support systems.

If is a four-letter word.

It's tough to take the *risk* out of *if*.

But a new idea in generating electric power can do that for electric utility executives.

If you're not sure what your future capacity ought to be, you should talk with General Electric. Just call our Business Information Center and ask about Progressive Generation or, as we call it, the GE PROGEN™ system.

Upfront, count on four major advantages.

Low capital requirements.

The ability to add capacity in small increments.

Short lead times.

And conversion to coal as a realistic alternative if gas and oil prices shoot up.

Say you need near-term capacity—and quickly. Highly reliable GE gas turbines meet the need. At just one-fifth the cost of a conventional plant burning coal. And they're on line in 12 months or less.

When your higher peak becomes the new base load demand? Add on steam turbines so you have a combined cycle plant. Efficiency bumps up 20%. And the cost advantage over a coal plant is a whopping 67%. Which means you could save up to $40 million per year.

Should your fuel prices go up substantially, you'll have the realistic option of adding on gasifiers so your combined cycle system can use coal.

All good reason to call (518) 438-6500 and ask about a GE PROGEN™ system.

No ifs, no ands, and no maybes.

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Table 1
Performance Test Results

Range	
SAE J227aC Cycle*	65 mi
Urban Driving	55 mi
Acceleration (0-30 mph)	
100% SOC**	11 sec
20% SOC	13 sec
Braking	
30-0 mph	51 ft
50-0 mph	156 ft
Gradeability Limit	18%
Energy Use (J227aC)	0.8 kWh/m

*Society of Automotive Engineers Delivery Cycle
**State of Charge

Table 2
Life-Cycle Cost

Life-Cycle Cost (cents/mi)	Conventional Van	Electric Van 1985	Electric Van 1985/86	Electric Van 1986/87
Depreciation—Vehicle	11.2	17.7	15.6	13.6
—Battery	—	11.1	11.1	9.8
Fuel/Electricity	10.4	5.0	5.0	5.0
Maintenance	14.0	7.0	7.0	7.0
Cost of Capital—Vehicle	3.5	5.8	5.1	4.4
—Battery	—	1.6	1.6	1.4
Total Life-Cycle Cost	39.1	48.2	45.4	41.2
Premium Over Conventional Van	—	+23%	+16%	+5%

that will include manuals, training, service assistance, parts supply and distribution, and warranties. TVA and Detroit Edison will initially augment this infrastructure system by providing guidance to participating utility fleets on electric van operation and maintenance.

The GM electric van was selected for this project because of its unique features including its proven performance and reliability, and its backing by a major automotive manufacturer. Manufactured in England, this van has a 106-inch wheelbase and a 2,200-pound payload capacity, and is traffic-compatible. Over $25 million has been spent on the development of the van and its electronic drive train, and it has accumulated over two million miles of road service. The GM Electric Van is being introduced into this country as the GM Griffon.

The Phase 1, Van Acceptance Testing, completed by TVA earlier this year, indicated that the Griffon performed extremely well throughout the 7,400-mile test. The results of these performance tests conducted through a joint EPRI/TVA EV Test and Evaluation Project at the TVA Electric Vehicle Test Facility are summarized in Table 1.

The current cost for this van, including shipping and duty, is approximately $20,000 at current exchange rates. By 1987, it is projected that the cost for this vehicle will be reduced to less than $16,000, a level that makes electric vans nearly cost-competitive with conventional fleet vans on a life-cycle cost basis. Table 2 provides a simplified life-cycle cost comparison for conventional and electric vans.

Planned technology developments, production increases, and reductions in shipping and duty through the transfer of some or all of the vehicle production to the U.S. will enable further and significant price reductions. Such price reductions will make it possible to market electric vans as a viable alternative to conventional vans for fleet applications.

The GM Electric Van Market Application Development Project is a bold and promising new step toward achieving the commercialization of market-responsive electric vehicles. As electric vehicles represent an attractive opportunity for load growth and load management for electric utilities, the industry and its customers alike stand to benefit from the successful commercialization of this emerging technology. EP

Contributed by the Electric Vehicle Development Corporation.

Megawatts vs. megabucks.

When users need more electricity, it usually means utilities have to sink a lot more money into their systems.

General Electric has a better alternative. Modernization.

One of the quickest ways to take a load off your balance sheet is to add today's technology to yesterday's steam turbine-generators. In less than two years' time, we can upgrade almost any machine to better-than-new.

One example: There are more than 200 GE units now running that can be retrofitted with our brand new 26″ low pressure, last stage design.

If your oil-fired steam turbine is a 300 MW unit, typical of that group, you'll save 28,500 barrels of oil every year through improved efficiency: That amounts to roughly $750,000.

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Here's another way to modernize: Putting a GE automatic turbine control on one of your generating units could cut an hour off each start-up cycle. One year's fuel savings can pay for the changeover.

And another: A new thermal performance monitor will track how efficiently your turbine is operating. Your operators will know how to optimize performance and when to schedule maintenance to improve operation.

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REGULATORY REVIEW

THE AVOIDED COST CONTROVERSY

The Public Utility Regulatory Policies Act (PURPA), one of the five statutes comprising the National Energy Act of 1978, contains several provisions designed to encourage the development of cogeneration and small power production. The intent of Congress in enacting these provisions was to improve the overall efficiency of electric power supply, displace the use of oil and natural gas, decentralize power production, and lessen some of the adverse environmental impacts caused by conventional central station electric power generation.

Section 210 of PURPA, which contains the bulk of that statute's provisions relating to cogeneration and small power production, requires the Federal Energy Regulatory Commission (FERC) to promulgate rules implementing Congress's program. Among other things, the law requires FERC to designate, by rule, the methodology for calculating rates to be paid by utilities for purchase of electricity from "Qualifying Facilities" (QFs), i.e., those cogenerators and small power producers which meet the eligibility criteria set forth in PURPA. PURPA provides a guaranteed market for a QF's electricity, requiring utilities to purchase it.

Congress required, in Section 210 of PURPA, that such rates must be just and reasonable to the utilities' customers and in the public interest, and that the rates may not discriminate against QFs. In addition, Congress placed a ceiling on the level of the rates, i.e., they may not exceed the incremental cost to the electric utility of alternative electric energy. FERC, in its rule implementing these provisions, chose to require that rates for purchases from QFs be based on "avoided cost." FERC defined avoided cost as the incremental cost to the utility of energy or capacity or both, which the utility would otherwise generate itself or purchase elsewhere.

This issue has proven to be one of the most hotly disputed ones under PURPA. The level of rates chosen has two important effects. First, it determines the impact of purchases from QFs on the utility's cost of power production and ultimately the electric bills of the utility's customers. Second, it influences how much cogeneration and small power production will actually be developed. Avoided cost (PURPA does not use the term) approximates the incremental cost ceiling imposed by Congress. FERC thus chose the option which gave the greatest possible encouragement to QF development, while effectively forestalling the possibility that any of the savings from development of cogeneration and small power production will be passed on to the customer.

Translating the avoided cost principle into practice has been a major area of controversy. Methodologies for computing and forecasting avoided costs vary widely. The differences are apparent not only in computational details but also in conceptual approaches to "incremental costs" as the basis for setting "avoided cost" rates. The major conceptual differences include:

- Whether short- or long-run marginal cost should be relied upon;
- The period over which costs should be measured;
- The method to be utilized for computing marginal cost; and
- The treatment of firm and non-firm capacity.

The alternative methods which are being employed to compute avoided cost cover:

- Long-run marginal cost methods using specific unit approaches or expansion planning approaches;
- Short-run marginal cost methods using as a basis for estimating avoided cost, or reference unit, incremental heat rate, or production costing models;
- Purchased power considerations;
- Differential revenue requirements approach; or
- Average incremental cost methods.

As a result of the differing approaches used to calculate avoided cost, it has been argued that some states are adopting rates for purchases from QFs which may exceed the utility's avoided costs. If payments to QFs are higher than the utility's own costs would have been to supply an equivalent amount of power, the customers' bills are higher than necessary. If the rates to be paid QFs are lower than the total avoided cost, the customers' bills are lower than they would have been if the purchase had not been made. Thus, payments to QFs in excess of the utility's true avoided cost could overstimulate cogeneration development and result in ratepayer subsidies. Payments below full avoided cost give less encouragement to cogeneration development.

A real shocker.

The bugaboo of every utility is stability problems.

It's usually caused by wild swings in voltage on transmission lines. But General Electric has a solution that makes them easy to control. And it's a lot less expensive than conventional ways.

The usual out has been to build new transmission lines or new power plants. One utility calculated the cost of building new lines to handle the problem at $75 million.

They decided to put in a GE Static Var Control which will act as a kind of shock absorber for the utility. It will help stop any chain-reaction effects that could shut down the lines. And keep saleable power flowing to customers.

The cost? About $4 million, or one twentieth that of the utility's only other option.

One of the best things about the GE Static Var Control is that it's not based on something untested, but has been in use for more than 10 years. And you can have one on line in less than two.

If you'd like information about an engineering analysis to see what a GE Static Var Control can do for your utility, call the GE Business Information Center at (518) 438-6500.

Sometimes there's more GE-whiz in something that's been around a long time than in things that are brand new.

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but pass on savings from cogeneration to the consumer.

PURPA clearly requires that the interests of ratepayers and QF developers be balanced. FERC's rules are clear that avoided cost purchase rates should not exceed the true costs actually avoided by the utility. This means that there should be indifference between the utility's sources of supply and purchases from QFs. Some state legislatures and/or commissions have sought, on their own authority, to require utilities to purchase power from QFs at prices above avoided cost. The question arose whether they were preempted by federal law from so doing.

So far, there are two decisions by state supreme courts on this question. The two cases are irreconcilable from the point of view of their reasoning on the question of federal preemption. Kansas has held that the state is preempted by PURPA from setting rates in excess of avoided cost; New York has held the opposite. In March 1985, the U.S. Supreme Court dismissed an appeal of the New York decision. Such a dismissal is a decision on the merits of the actions. Two justices dissented, objecting to the summary disposition of a question which will, they recognized, recur; there is litigation in several other states on the matter. It is likely that the question will again come before the Supreme Court in the next few years. EP

Contributed by the Finance and Regulation Department of Edison Electric Institute

STATISTICAL REVIEW

Table 1
Quarterly Electric Output (TWh)

Quarter	1984	1983	Percent Increase
First	612.3	559.8	9.4
Second	592.2	547.8	8.1
Third	654.0	652.0	0.3
Fourth	593.3	588.0	0.9
Year	2,451.7	2,347.6	4.4

Source: Edison Electric Institute Weekly Electric Output

1984 Electric Output

A strong demand for electricity during the first half of 1984 increased the annual electric output to a new high of 2,451.7 Terawatthours (TWh) (see Table 1). (Note: one Terawatthour equals one billion kilowatthours.) The 1984 output surpassed the 1983 output (2,347.6 TWh) by 4.4 percent. This growth was triggered by a combination of a strong rebound in the industrial sector and harsh weather conditions in the first quarter.

1984 in Review

A vigorous recovery in industrial production and very cold weather gave a big boost to electric output during the first quarter of 1984 (9.4 percent) when compared to the same period a year earlier (see Table 1). The highest industrial gain was experienced in the Central industrial region, regaining losses suffered in the 1981-82 recession. In addition, the Mountain region rebounded in 1984 after enduring the worst economic downturn in almost 20 years.

The second quarter continued with a strong demand for electricity from the industrial sector before leveling off. The effects of weather on electric output began early in May. On some days temperatures during this period reached levels as high as those of June 1983. June 1984 weather increased the demand for electricity from the residential and the industrial sectors to effect an 8.1 percent change over the same period in 1983.

The heat of the summer produced the highest electricity output for the week ending August 11, 1984, showing a record 54.1 TWh. The previous summer record occurred during the week ending July 23, 1983, with an output of 53.6 TWh. Even though the electric output for the third quarter produced a record figure, the increase was only 0.3 percent over the same quarter a year earlier.

Weather patterns during the last quarter of 1984 remained constant. As a result, the effect of residential and industrial demand for electricity during the first two months of the fourth quarter increased moderately at 4 and 5 percent, respectively, when compared to 1983. The effects of a mild December, with the exception of the cold wave that swept over the Rocky Mountain, Pacific Northwest, and Pacific Southwest regions, decreased the electric output to −4.7 percent as compared to December 1983. Electric output for the last three months of the year increased 0.9 percent over the same period in 1983. EP

Contributed by the Statistics Department of Edison Electric Institute.

Rethinking an axiom.

Conventional wisdom in the utilities business says that power transformers are so big and so expensive that you don't replace them unless something drastic happens.

Something did.

General Electric has developed new power transformers that are so reliable and so efficient that for each older power transformer you have on line, savings can approach a million dollars, based on evaluations now being used.

Ten to fifteen years ago, as you well know, the common axiom in buying power transformers was "lowest cost even at higher loss." The oil crisis changed all that to "lowest loss even at higher cost." Every advance we've made in design and testing technology, from core to coils and from clamps to tank, has focused on improving reliability and efficiency.

In some cases, based on improved efficiency alone, new GE transformers can pay off the initial investment in less than five years. If you factor in the improvement in reliability, the payback period will be further reduced.

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Call the GE Business Information Center at (518) 438-6500 if you'd like us to run a computer evaluation study using your own numbers. It's not unusual to find that the cost of losses on a power transformer only 10 to 15 years old is equal to or more than the price of a brand new unit.

One axiom still holds true: The surest way to make money is to invest some.

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BOOK REVIEW

FOREVERMORE: NUCLEAR WASTE IN AMERICA

Donald L. Barlett and James B. Steele
W. W. Norton and Company, 1985
New York, 352 pp.

By James B. Hall

Diamonds may be forever (at least according to popular folklore) but radiation from nuclear waste generated on this earth is certainly not. The catchy title of the book itself belies a fundamental truth about radioactivity which the authors never bother to accurately explain. Radioactive materials do degrade, that is to say, the level of radioactivity decreases until a stable situation exists. This is not the case with many far more readily available toxic chemical substances.

A principal reason for the difficulty of dealing with nuclear wastes in this country is the misperception by the public, and accompanying fears, generated by greatly exaggerated accounts of the risks involved—such as those described in this book. Donald L. Barlett and James B. Steele are investigative reporters for the *Philadelphia Inquirer*. Their book is an expanded version of a series of newspaper articles. The chapter titles are illustrative of their focus:

Atomic Technology: Fantasy versus Reality
The Politics of Neglect
The Failure of Reprocessing
The Bid to Revive Reprocessing
The Buildup of High-Level Waste
The Search for a Repository
Losing Track of Waste
Burial-Ground States Revolt
A Dump in Every State
The Supersalesman of Nuclear Waste
America's Favorite Dump Site
Radiation, Waste, and the National Health

To objectively evaluate the issues raised by the authors would require a separate text of at least equal length to assess their one-sided, exaggerated sensationalism. Historians they are not. What is absent from this book is a balanced perspective on a challenging subject. Three themes continue to recur throughout their writing: (1) radioactive waste is the most hazardous substance on earth; (2) scientists and engineers do not know how to store or dispose of radioactive waste; and (3) politicians have failed miserably in dealing with the problem.

The hazards of radioactive waste are very important to understand so that an objective assessment of risk or relative risk can be made. Nowhere do the authors discuss what radioactivity is, where it comes from, the different kinds of radiation, and the known biological effects of radiation. Nor do they discuss the natural radiation from the ground and from cosmic rays which bombard the earth constantly. They do not mention the natural radiation from the minerals in stones or bricks in houses, the radioactive potassium in our bodies or the increased exposure to cosmic rays at higher elevations (such as is received by those who ride in high-flying jet aircraft). Instead, they alarm the reader with such statements as: "By the year 2000, it is projected, waste stockpiles will top 42 billion curies—enough to kill everyone on the face of the earth." Interesting, but irrelevant. A similar remark could be made regarding a whole host of toxic substances if one presumes such material would be meted out to every individual and that every individual would be crazy enough to swallow, hold or otherwise expose himself or herself to the danger.

Do scientists and engineers know how to store and dispose of radioactive waste? The authors infer that the termination of experiments to launch an atomic spaceship, the early problems with disposing of low-level wastes in wet regions using conventional shallow land burial technology, carelessness in transportation of wastes, and the non-viability of reprocessing are all proof positive that scientists and engineers don't know what they are doing. Hence, Barlett and Steele conclude, current plans for spent fuel/high-level waste geologic repositories and continual support (with Nuclear Regulatory Commission blessing) of shallow land burial technology for low-level waste disposal are not credible. The conclusions implied are not supported by the evidence presented. The examples referred to are really independent separate issues. It would have been helpful if the authors had tried to separate fact from fiction and differentiate between what is well known and what is less well known.

Unfortunately, the technical community has tended to oversimplify the challenge with such statements as, "We don't have any technical problems regarding waste disposal—just political ones." There are some technical problems which still need to be resolved for spent fuel/high-level waste disposal. While the physics of radioactive decay are well understood, the engineering complexities of containment of high-level radioactive wastes in specific geohydrologic settings for extremely long time periods need to be carefully worked out. Current plans of the Department of Energy (DOE) call for extensive site-characterization activities extending over a period as long as five years for each of the recommended repository sites. These activities should provide the earth scientists with sufficient information to evaluate the ability of a particular host medium to contain high-level nuclear wastes. It should also reveal the information needed to optimize the design of a waste package to match the properties of waste materials and geohydrologic

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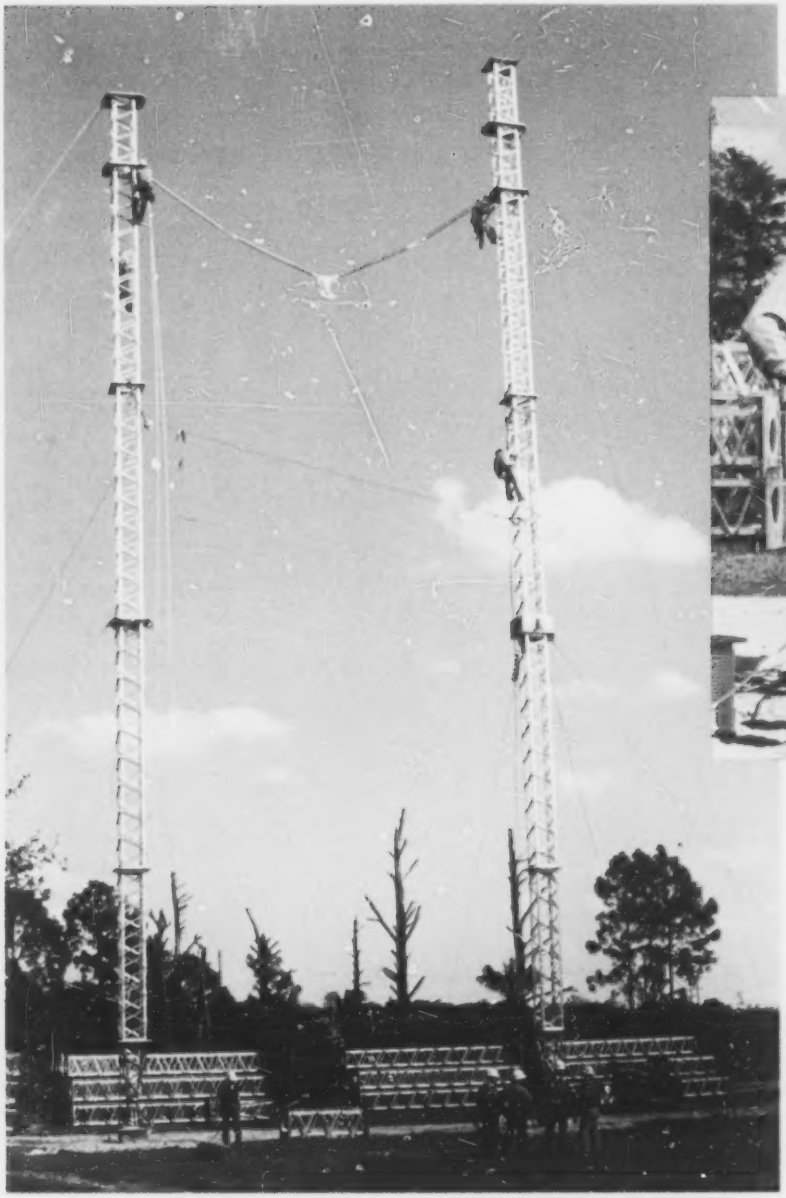

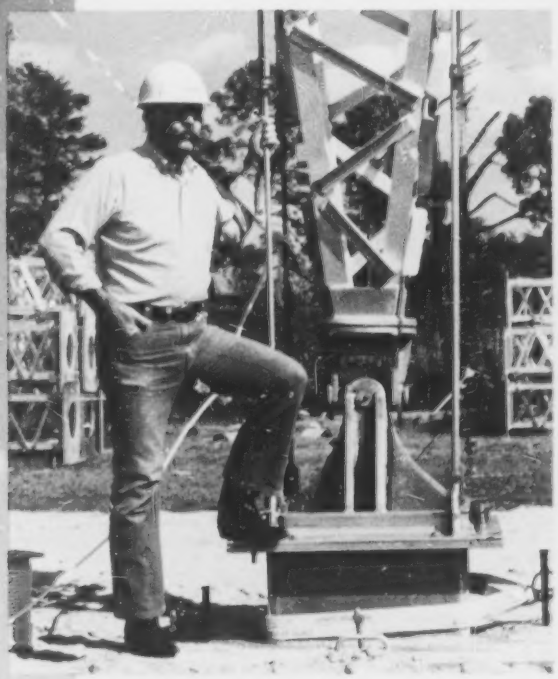

Bill Cole, Manager of System Transmission Operations, says "Florida Power & Light Company is pleased with the emergency transmission structures supplied to us by Lindsey Manufacturing. The quality, fit and product are according to our specifications in every way. The crew training for the use of these structures has progressed very well and we are now prepared to use them should the occasion arise. The crews reception to this concept was excellent."

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settings. A more balanced presentation by the authors would have pointed out in detail the careful planning underway by DOE to ensure the adequacy of any site for a geologic repository.

Barlett and Steele paint a particularly grim picture of the ability of the federal government to meet the political challenges of dealing with nuclear waste. They do treat Congress, DOE, and the many regulatory agencies in equally poor fashion, that is, with great disdain for their actions during the last several decades.

There is a lengthy presentation of some of the problems associated with the regional compact formulation mandated by the Low-Level Radioactive Waste Policy Act of 1980. To be sure, the road has been rocky, and it may be questionable whether Congress will approve the six compacts introduced thus far, unless access for the regions or states without established sites can be assured for a reasonable time period. Yet the authors might have given more credit where credit is due. The difficult compact process is proceeding, and the "regional chaos" they describe is currently being debated in the form of some promising amendments to the Low-Level Waste Policy Act which have only recently been introduced in Congress. While these latest actions have occurred since the book was published, they do reflect the fact that things may well not be as hopeless as the authors suggest.

In a democracy such as ours, it is indeed difficult to forge a consensus of support for establishing nuclear waste disposal sites that few seem to want or recognize the need for—especially after fears and misperceptions have been fueled by articles and books such as this one.

However, lest those with technical backgrounds in nuclear fields are too quick to criticize, it is important to consider when a comprehensive treatise dealing with radioactive waste, suitable for reading by the public, was last written by members in their ranks. If nuclear physicists, government planners, utility industry spent fuel specialists, and nuclear industry technicians would leave the writing to investigative reporters, they must be prepared to accept the results, namely, the absence of accurate, balanced descriptions of what radiation and radioactive wastes are and, most importantly, the relative risks of dealing with radioactive materials. They should read this book. It is not nuclear waste, but rather the waste created by such exaggerations, misperceptions, and resultant fears that may well be with us forevermore. EP

James B. Hall is Director of the Utility Nuclear Waste Management Group, Edison Electric Institute.

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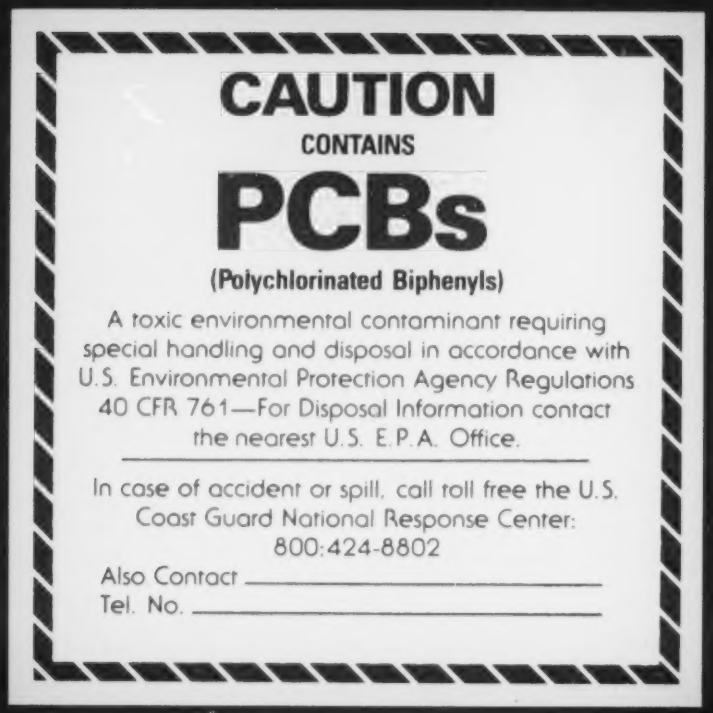
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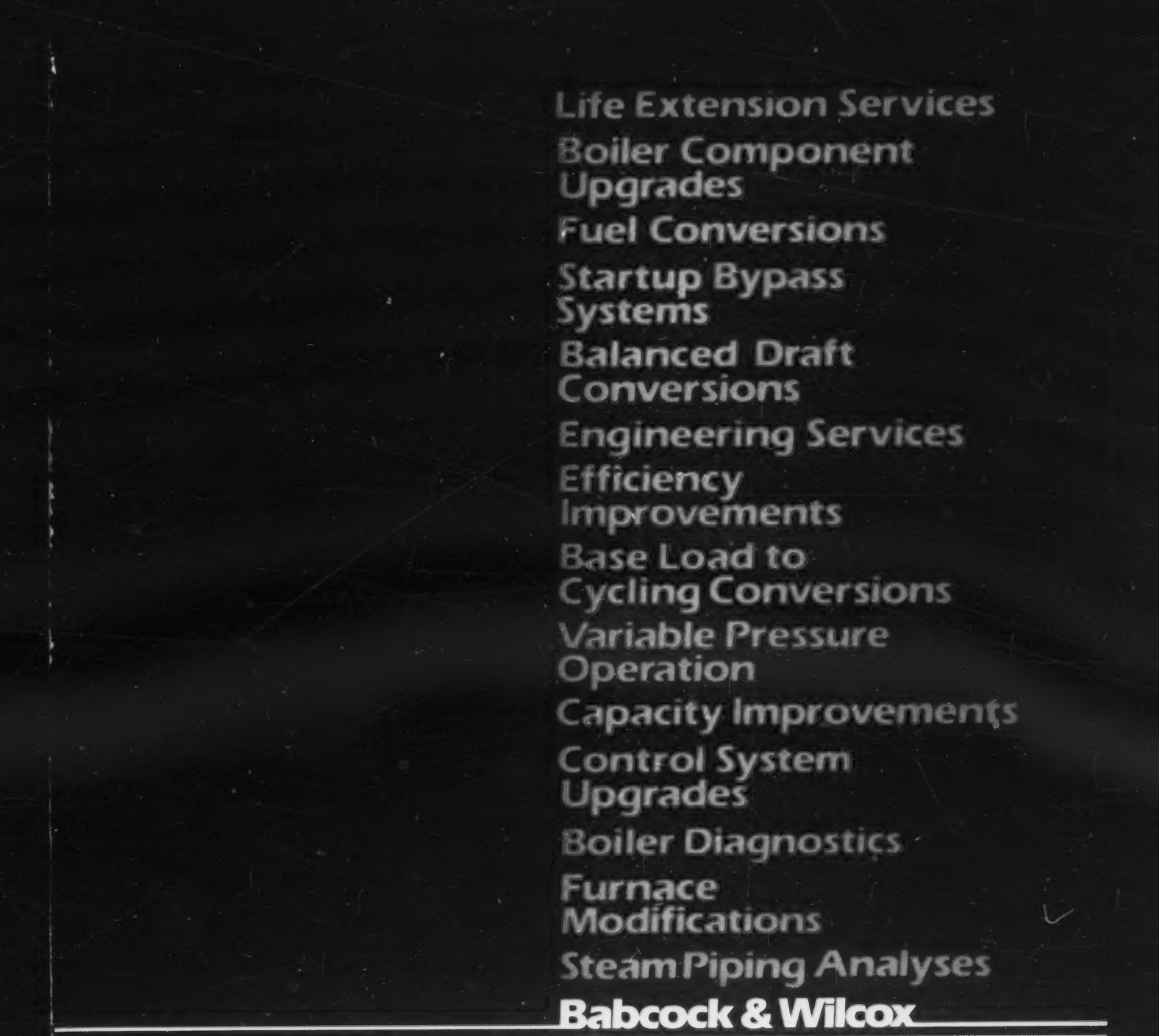

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